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SELECTED WATER RESOURCES ABSTRACTS

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JUNE 1986

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1986.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

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08 ENGINEERING WORKS

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

CONDUCTANCE: A COLLECTIVE MEASURE OF DISSOLVED IONS,
Geological Survey, Menlo Park, CA.
J. D. Hem.
IN: Water Analysis, Academic Press, Orlando, FL. 1982, Volume 1: Inorganic Species, Part 1. p 137-161, 7 fig, 28 ref.

Descriptors: *Conductance, *Physical properties, *Chemical properties, *Conductivity, *Specific conductivity, Dissolved solids, Natural waters, Salinity, Ions, Irrigation water, Trace elements, Physiochemical properties.

The physical basis for electrical conductance in aqueous solutions, the influence of solute concentrations and related factors on conductance, and the ways in which these influences are evaluated are examined. The specific conductance of a substance is the conductance over 1 cm of a segment of the material having a cross-sectional area of 1 sq cm. The equivalent conductance of a solute is the conductance of one gram of the material dissolved in water. Major factors affecting limiting equivalent conductances include ionic size, charge and speed. Increased temperatures bring about increased ion movement. Conductivity cells usually have platinum electrodes. Compensations that can be made for temperature effects, and types of measuring instruments are described. Conductivity values are related to salinity and have been used to evaluate the usability of water for irrigation or other purposes or the need for correcting undesirable salinity levels in soils. The conductivity of natural waters varies considerably depending upon dissolved solids content. Conductivity measurements may also be applied to the calculation of total ionic concentrations in equivalents per liter, the estimation of ionic strength of solutions, and the estimation of the gravimetric dissolved solute concentration. (Geiger-PTT)
W86-02261

2. WATER CYCLE

2A. General

WATER RESOURCES AND EFFECTS OF DEVELOPMENT IN HERNANDO COUNTY, FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
J. D. Fretwell.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4320, 1985. 83 p, 33 fig, 7 tab, 61 ref.

Descriptors: *Groundwater, *Water supply, Water quality, *Saltwater intrusion, Karst Floridan aquifer system, Hernando County, *Florida.

In spite of the hill and valley terrain in the Brooksville Ridge area of Hernando County, Florida, little surface drainage occurs within the county. Recharge to the Floridan aquifer system occurs as infiltration of precipitation within the county or as ground-water flow from Sumter County to the east and Pasco County to the south. Discharge is principally to the Gulf of Mexico, but some ground water flows north into Citrus County before it reaches the Gulf. The Floridan aquifer system is generally unconfined. Water quality is generally good except near the coast where high chloride occurs. Water from the Floridan aquifer system accounted for 87 percent of the water used for irrigation, industry, and rural and public supply in 1982. Sixty-seven percent of this water was used by industry. Rock mining, the major industry, used 99 percent of the industrial water. The anticipated increase in population in the county between 1982 and 2000 will increase demand for water primarily from public water-supply systems. This higher demand will cause about a 1 percent reduction in flow from Weeki Wachee Springs, but little change in lake levels or saltwater intrusion will occur if the projected additional supplies are developed far enough inland from the coast. (USGS)
W86-01931

HABITAT SUITABILITY INDEX MODELS: REGRESSION MODELS BASED ON HARVEST OF COOLWATER AND COLDWATER FISHES IN RESERVOIRS,
Fish and Wildlife Service, Fayetteville, AR. National Reservoir Research Program.
L. R. Aggus, and W. M. Bivin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-147348, Price codes: A03 in paper copy, A01 in microfiche. Report FWS/OBS-82/10.25, September 1982. 38 p, 1 fig, 5 tab, 14 ref, 4 append.

Descriptors: *Habitat, *Fisheries, *Reservoir fisheries, *Mathematical models, *Fish harvest, Reservoirs, Fish, Lake fisheries, Regression analysis, Models, Model studies.

Habitat suitability index models were developed for selected coolwater and coldwater fishes in reservoirs. The models were based on estimates of harvest and were designed for use in existing and proposed coolwater and coldwater reservoirs in the contiguous United States. The analysis of reservoir harvest data consisted of development of multiple regression equations to predict harvest of selected fishes; conversion of these values to indices of habitat suitability; and exploration of discriminant analysis as an alternate quantitative approach. The feasibility of classifying reservoirs on the basis of grouped harvest of selected sport fishes, then predicting group membership based on environmental characteristics of a reservoir was also tested with discriminant analysis. The multiple regression equations presented herein are easily programmed to permit users to input environmental data and receive harvest and cumulative frequency values as output. The use of environmental factors to predict harvest in coolwater and coldwater reservoirs may remain relatively imprecise. Discriminant analysis did not produce precise classification schemes in reservoirs. Quantitative methods for identifying appropriate levels of harvest should be sought and tested before the procedure is abandoned. (Geiger-PTT)
W86-01985

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN GROUNDWATER MODELING: SELECTION, TESTING AND USE,
Michigan Dept. of Natural Resources, Lansing.
For primary bibliographic entry see Field 2F.
W86-02034

RAINFALL-RUNOFF RELATIONSHIPS AND WATER-QUALITY ASSESSMENT OF COON CREEK WATERSHED, ANOKA COUNTY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
A. D. Arntson, and L. H. Tornes.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4013, 1985. 97 p, 17 fig, 17 tab, 42 ref.

Descriptors: *Rainfall-runoff relationships, *Hydrograph modeling, Streams, Antecedent moisture, HEC-1, Water quality, Urbanization, Chemical properties, Biological properties, Regression techniques, Bottom materials, Loading, Sediment, Coon Creek, Anoka County, *Minnesota, Anoka Sand Plain.

Rainfall-runoff relationships were studied and a water-quality assessment was done for the 96.9-square-mile Coon Creek watershed, Anoka County, Minnesota. Data were collected from March 1979 to November 1980 at three continuously recording rainfall sites, five continuously recording streamflow sites, and seven creststage sites. Hydrograph analyses showed larger peak flows, shorter times to peak, and shorter duration of high flows in streams draining urban areas than in streams draining rural areas. Constrictions at roadways resulted in attenuation of hydrograph peaks in urban areas. Eight storms produced 19 hydrographs suitable for simulation with the HEC-1 model program. Parameter-optimization techniques were used to produce synthetic hydrographs that closely resemble observed hydrographs. Linear regression was used to relate rainfall and antecedent-moisture conditions in each of the subbasins to HEC-1 input parameters, resulting in generalized models that satisfactorily match 15 of 19 observed hydrographs. Water quality was determined from 1 bottom-material and 14 water samples from each of 4 sites. Results showed that urban runoff carried the highest areally adjusted loads of several metals, chloride, dissolved solids, and suspended sediment. The highest areally adjusted loads of most nutrients were found in mainstem segments of streams in rural areas. (USGS)
W86-02370

APPLICATION OF THE U.S. GEOLOGICAL SURVEY'S PRECIPITATION-RUNOFF MODELING SYSTEM TO THE PRAIRIE DOG CREEK BASIN, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
L. E. Cary.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4178, 1984. 98 p, 16 fig, 30 tab, 64 ref.

Descriptors: *Parametric hydrology, Hydrologic models, Model Studies, Model testing, *Rainfall-Runoff relationships, *Semiarid lands, Prairie Dog Creek basin, Tongue River basin, *Montana.

The U.S. Geological Survey's precipitation-runoff modeling system was tested using 2 year's data for the daily mode and 17 storms for the storm mode from a basin in southeastern Montana. Two hydrologic response unit delineations were studied. The more complex delineation did not provide superior results. In this application, the optimum numbers of hydrologic response units were 16 and 18 for the two alternatives. The first alternative with 16 units was modified to facilitate interfacing with the storm mode. A parameter subset was defined for the daily mode using sensitivity analysis. Following optimization, the simulated hydrographs approximated the observed hydrograph during the first year, a year of large snowfall. More runoff was simulated than observed during the second year. There was reasonable correspondence between the observed snowpack and the simulated snowpack the first season but poor the second. More soil moisture was withdrawn than was indicated by soil moisture observations. Optimization of parameters in the storm mode resulted in much larger values than originally estimated, commonly larger than published values of the Green and Ampt parameters. Following optimization, variable results were obtained. The results obtained are probably related to inadequate representation of basin infiltration characteristics and to precipitation variability. (USGS)
W86-02390

CALIBRATION PROCEDURE FOR A DAILY FLOW MODEL OF SMALL WATERSHEDS WITH SNOWMELT RUNOFF IN THE GREEN RIVER COAL REGION OF COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
J. M. Norris, and R. S. Parker.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4263, 1985. 32 p, 18 fig, 8 tab, 10 ref.

Descriptors: *Model studies, *Snowmelt, *Calibrations, Soil water, *Runoff prediction, *Colorado, *Precipitation-Runoff Modeling System.

A calibration procedure was developed for the U.S. Geological Survey's Precipitation-Runoff Modeling System for watersheds in which snowmelt is the major contributor to runoff. The model uses daily values of air temperature and precipita-

tion as input and the output is mean daily discharge. The procedure appears sufficient to calibrate both streamflow volume and the timing of mean daily discharge if other model parameters are reasonably estimated. Model structure and sensitivity analysis suggest that one of the most important parameters is the available water-holding capacity of the soil (SMAX). Changing this parameter through a series of iterations, the calibration procedure minimizes the error between observed and predicted annual discharge. The calibration suggests that the single parameter SMAX may be sufficient for optimizing both the volumes and the timing of runoff, assuming other model parameters are adequately estimated. Additional optimization on parameters sensitive to timing does not appear to improve prediction. This indicates that these parameters were estimated accurately prior to calibration. Further investigation is needed on more watersheds to determine SMAX's ability to calibrate volume and timing with a constant set of other model parameter values. (USGS)
W86-02403

2B. Precipitation

SCPP DATA COLLECTION AND ANALYSIS FOR THE PERIOD 1 JANUARY 1979 THROUGH 30 SEPTEMBER 1984: VOLUME ONE - EXECUTIVE SUMMARY,
Atmospherics, Inc., Fresno, CA..
Final Report, September 1984. 35 p, 1 fig. 9-07-85-V0020.

Descriptors: *Weather modification, *Precipitation, *Data collections, Orographic precipitation, Supercooling, Meteorological data collections, Cloud physics, Cloud seeding, *Sierra Cooperative Pilot Project, Sierra Nevada Mountains, Measuring instruments, Snow, Ice, *California.

This volume (1 of 3) briefly summarizes all weather modification data collection and analysis tasks performed by Atmospherics Incorporated during the period 1 January 1979 through September 1984 within the Sierra Cooperative Pilot Project. The major categories of work included the installation, operation, and maintenance of, plus data collection and analysis from (1) a network of precipitation gages, (2) ground-based instrumentation for the detection of supercooled liquid water, (3) a network of surface meteorological stations, (4) a fixed microphysics station, (5) snow and high-volume air samplers and (6) NCAR Ice Nucleus counters. Summaries of work performed during the six seasons of field activities, including data acquition, data processing, instrument calibration, and maintenance and anlaysis efforts, are presented. (Author)
W86-01984

THUDERSTORMS: A SOCIAL, SCIENTIFIC, AND TECHNOLOGICAL DOCUMENTARY. VOLUME 3: INSTRUMENTS AND TECHNIQUES FOR THUNDERSTORM OBSERVATION AND ANALYSIS.
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-146076, Price codes: A14 in paper copy, A01 in microfiche. April 1982. Edited by Edwin Kessler. 313 p.

Descriptors: *Thunderstorms, *Radar, *Data acquisition, *Satellite technology, *Meteorological data collections, Storms, Tornadoes, Rainstorms, Photogrammetry, Hail, Networks, Acoustics, Data collections, Weather data collections, Instrumentation, Networks.

This third and last volume of a comprehensive documentation of thunderstorms presents tools and techniques for acquisition and analysis of data on thunderstorms. Topics covered include: station networks for storm observation, tornado interception with mobile teams, observations from instrumented aircraft, photogrammetry of thunderstorms, storm acoustics, infrasound from thunderstorms, sferics and other electrical techniques for storm investigations, observation and measurement of hailfall, and the use of satellite observations. An appendix to the chapter on measuring storm rainfall is included which provides mathematical equations to adjust for various biases caused by receivers, rainfall, attenuation, clouds and atmospheric gases. (Geiger-PTT)
W86-02003

STATION NETWORKS FOR STORM OBSERVATION,
National Weather Service, Sterling, VA. Test and Evaluation Div.
For primary bibliographic entry see Field 7B.
W86-02004

OBSERVATIONS FROM INSTRUMENTED AIRCRAFT,
National Oceanic and Atmospheric Administration, Boulder, CO. Weather Modification Program Office.
For primary bibliographic entry see Field 7B.
W86-02005

OBSERVATION AND MEASUREMENT OF HAILFALL,
National Center for Atmospheric Research, Boulder, CO. Convective Storms Div.
For primary bibliographic entry see Field 7B.
W86-02007

QUALITY AND QUANTITY OF URBAN RUNOFF AND ATMOSPHERIC DEPOSITION IN URBAN AREAS OF SALT LAKE COUNTY, UTAH, 1980-1981,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02346

FLOODS OF APRIL 18, 1983 ON ST. THOMAS AND ST. JOHN, U.S. VIRGIN ISLANDS,
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02362

2D. Evaporation and Transpiration

APPLICATION OF A PLANT-ENVIRONMENT MODEL TO PROBLEMS IN IRRIGATION,
Nebraska Univ., Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W86-02128

INSTRUMENTATION FOR MEASURING LAKE AND RESERVOIR EVAPORATION BY THE ENERGY-BUDGET AND MASS-TRANSFER METHODS,
Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-02379

2E. Streamflow and Runoff

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1984,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-01926

EVALUATION OF THE SURFACE-WATER DATA NETWORK, SUWANNEE RIVER BASIN, FLORIDA, 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-01936

HYDROLOGY OF AREA 11, EASTERN COAL PROVINCE, OHIO, KENTUCKY, AND WEST VIRGINIA,
Geological Survey, Columbus, OH. Water Resources Div.
D. K. Roth, and S. C. Cooper.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-233, 1984. 66 p, 45 fig, 4 tab, 73 ref.

Descriptors: *Coal Mines, *Environmental Effects, Mine Drainage, Water Quality, Erosion, Sedimentation, *Eastern Coal Province, *Ohio, Kentucky, West Virginia.

The Eastern Coal Province is divided into 24 separate hydrologic reporting areas. The division is based on hydrologic factors, location, size, and mining activity. Area 11 of the Eastern Coal Province comprises 3,190 square miles of southeastern Ohio, northeastern Kentucky, and western Virginia. Except for the wide, flat flood plain along the Ohio River, it consists mainly of rolling hills. Most of the area is forested. Precipitation in the area ranges from 39 inches per year in the north to 45 inches per year in the south. Coal seams 1 to 4 feet thick are found in rocks of Pennsylvanian age that crop out in Area 11. Surface mining of coal is concentrated in the Ohio part; surface mines are scattered throughout the Kentucky part, and there are no known mines in the West Virginia part. Most of the streams that drain less than 100 square miles normally approach zero flow from late June through October. The average value of the 50-percent daily duration flow (based on eight stations) is 0.37 cubic feet per second per square mile. The 2-year flood-peak magnitude (based on seven stations) ranges from 10.8 to 138 cubic feet per second per square mile; the average 2-year flood peak is 43.8 cubic feet persecond per square mile. The pH of sampled streams ranged from 2.6 to 8.8. The median pH at mined sites was 5.4 whereas the median pH at unmined sites was 7.3. Dissolved iron concentrations ranged from 0 to 150,000 micrograms per liter; medians were 893 micrograms per liter at mined sites and 90 micrograms per liter at unmined sites. Sulfate concentrations ranged from 9.8 to 2,100 milligrams per liter; medians were 203 milligrams per liter at mined sites and 50 milligrams per liter at unmined sites. Although water wells in alluvium along the Ohio River produce up to 1,500 gallons per minute, bedrock wells throughout most of Area 11 typically yield only 1 or 2 gallons per minute. Chemical analyses of ground water indicate that bicarbonate is the major anion in Area 11; calcium and sodium are the major cations. (USGS)
W86-01937

EFFECTS OF URBANIZATION OF THREE PONDS IN MIDDLETON, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-01949

EVALUATION OF RAINFALL-RUNOFF DATA FOR THE DENVER FEDERAL CENTER, LAKEWOOD, JEFFERSON COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
R. D. Jarrett, and J. E. Veenhuis.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4050, 1984. 67 p, 11 fig, 7 tab, 24 ref.

Descriptors: *Storm runoff, *Streamflow, Water management, *Rainfall-runoff relations, *Hydrograph analysis, *Floods, Flow discharge, Thunderstorms, Streamflow gages, Rain gages, Data collections, Stage-discharge relations, *Colorado, Jefferson County, Lakewood, Denver Federal Center.

An investigation was made to monitor the storm runoff in McIntyre Gulch basin to determine the rainfall-runoff chracteristics. Results may now be used to evaluate the effects of future development

on storm runoff from the Denver Federal Center, which is located in the McIntyre Gulch basin in Lakewood, CO. Rainfall and runoff data were collected at eight streamflow stations and three auxiliary rainfall stations in and adjacent to the Denver Federal Center. The outflow peak discharges from McIntyre Gulch in the Denver Federal Center were higher than the inflow peak discharges for eight of the storms by an average of 38 percent. Outflow peak discharges for eight of the storms were lower by an average of 12 percent. The study demonstrated that runoff varies with location of a storm--even for a relatively small basin. Peak discharges of McIntyre Gulch outflow from the Denver Federal Center were 27 percent greater than the inflow for all storms, but only 15 percent greater for evenly distributed storms. Runoff from the Denver Federal Center increased storm-runoff volumes in McIntyre Gulch by an average of 46 percent. Proper management of storm runoff in the Denver Federal Center requires that proposed improvements to the existing storm-runoff system maintain peak flows at their present levels. (USGS)
W86-01956

DETERMINATION OF REAERATION COEFFICIENTS FOR OHIO STREAMS,
Geological Survey, Columbus, OH. Water Resources Div.
J. Hren.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4139, 1984. 25 p, 1 fig, 3 tab, 10 ref.

Descriptors: *Aeration, *Ohio, Streams, *Reaeration, Regression analysis, Tracers, *Reaeration coefficients, Hydrocarbon tracers.

The hydrocarbon gas tracer technique was used to determine reaeration coefficients on 30 reaches of Ohio streams. The studies were done from September 1979 through August 1982 to determine the reaeration coefficients for the individual reaches and to develop general equations that could be used to estimate the coefficients. Multiple linear regression was used to determine relationships among the reaeration coefficients and physical stream characteristics. Four special equations based on the general information were developed from various combinations of discharge, slope, width, depth, measured velocity, and estimated velocity. The standard errors of estimate for these equations ranged from 37 to 46 percent. The variables that resulted in the lowest standard error of estimate were discharge, slope, width, depth, and measured velocity. The most significant variables were depth and velocity. (USGS)
W86-01958

COST-EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY STREAM-GAGING PROGRAM IN ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-01961

COMPILATION OF DATA COLLECTED AND DERIVED FOR WATER YEARS 1980 AND 1981 FOR THE PURPOSE OF WATER-QUALITY MODELING OF THE LOWER OUACHITA RIVER AND SELECTED TRIBUTARIES, SOUTH-CENTRAL ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01965

STREAMFLOW ROUTING IN THE SCHOHARIE CREEK BASIN, NEAR NORTH BLENHEIM, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
S. W. Wolcott.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4054, 1983. 20 p, 4 fig, 3 tab, 7 ref.

Descriptors: *Flood Routing, *River Forecasting, *Model Studies, Historic Flood, Hydrographs, *New York, Schoharie Creek, HEC-1 model.

A flow-routing model of the upper Schoharie Creek basin, New York, was developed and used to simulate high flows at the inlet of the Blenheim-Gilboa Reservoir. The flows from Schoharie Creek at Prattsville, the primary source of flow data in the basin, and tributary flows from the six minor basins downstream, are combined and routed along the 9.7 mile reach of the Schoharie Creek between Prattsville and the reservoir inlet. Data from five historic floods were used for model calibration and four for verification. The accuracy of the model as measured by the difference between simulated and observed total flow volumes, is within 14 percent. Results indicate that inflows to the Blenheim-Gilboa Reservoir can be predicted approximately 2 hours in advance. One of the historical floods was chosen for additional model testing to assess a hypothetical real-time model application. Total flow-volume errors ranged from 30.2 percent to -9.2 percent. Alternative methods of obtaining hydrologic data for model input are presented for use in the event that standard forms of hydrologic data are unavailable. (USGS)
W86-01968

ASSESSMENT OF WATER RESOURCES AT FORT CARSON MILITARY RESERVATION NEAR COLORADO SPRINGS, COLORADO,
Geological Survey, Pueblo, CO. Water Resources Div.
G. J. Leonard.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4270, 1984. 124 p, 21 fig, 18 tab, 32 ref.

Descriptors: *Surface water, *Groundwater, *Water quality, *Colorado, El Paso County, Fort Carson Military reservation, Arkansas River Valley, Front Range Urban Corridor, Water supply, Data collections.

The Fort Carson Military Reservation adjoins the rapidly growning Colorado Springs metropolitan area, where locally available water supplies are limited and strictly administered. Fort Carson purchases about 3,400 acre-feet of treated water annually from the city of Colorado Springs. The major streams entering Fort Carson have an estimated average annual discharge of 6,240 acre-feet of water per year upstream from diversions for municipal and domestic water supplies. The streamflow is unevenly distributed in time and consequently not dependable as a large or sole source of water. Ground water is available from alluvial and bedrock aquifers. Wells with yields greater than 100 gallons per minute can be expected from the alluvium along Rock and Little Fountain Creeks and from some parts of the Dakota-Purgatoire aquifer. The quality of surface water entering Fort Carson is generally suitable for irrigation and drinking but deteriorates eastward across Fort Carson. Water from the alluvial aquifer along Rock and Little Fountain Creeks in the eastern part of Fort Carson contains fluoride in concentrations exceeding drinking-water standards. Water from the Dakota-Purgatoire aquifer characteristically contains radiochemical constituents in concentrations that exceed drinking-water standards. (USGS)
W86-01969

SURFACE WATER RESOURCES OF SOUTH AFRICA; VOLUME I: DRAINAGE REGIONS A, B-THE LIMPOPO-OLIFANTS SYSTEM,
University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit.
B. J. Middleton, W. V. Pitman, D. C. Midgley, and R. M. Robertson.
Report No. 10/81; Part 2 (Appendices), March 1982. 331 p.

Descriptors: *Surface-groundwater relations, *Groundwater, *Data processing, Rivers, Limpopo River, Olifants River, South Africa, Data collections, Computer programs, Runoff, Reservoirs, Frequency analysis, Sediment yield, Rainfall, Streamflow, Evaporation, Meteorological data collection, Synthetic hydrology, Watersheds, Hydrology, Flow duration, Land use, Precipitation.

The appendices to Part 1 contain the following information on the Limpopo-Olifants system of South Africa: (A) hydrometeorological data (rainfall, streamflow, evaporation), (B) land use (irrigation, afforestation, reservoirs), (C) breakdown of tertiary catachments, (D) synthetic hydrology, (E) quaternary subcatchments, (F) storage requirements (flow duration-frequency plots, hydrological zones, evaporation loss, sediment yield), and (G) users guide to computer programs. (Cassar-PTT)
W86-01990

SURFACE WATER RESOURCES OF SOUTH AFRICA; VOLUME IV: DRAINAGE REGIONS E, G, H, J, K, L - THE WESTERN CAPE,
University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit.
W. V. Pitman, D. J. Potgieter, B. J. Middleton, and D. C. Midgley.
Report No 13/81: Part 2(Appendices), May 1982. 521 p.

Descriptors: *Hydrologic data, *Surface waters, Surface-groundwater relations, *Groundwater, *Data processing, Rivers, *South Africa, Data collections, Computer programs, Runoff, Reservoirs, Frequency analysis, Sediment yield, Rainfall, Streamflow, Evaporation, Meteorological data collection, Synthetic hydrology, Watersheds, Hydrology, Flow duration, Land use, Precipitation.

The appendixes to Part 1 contain the following information on the Western Cape region of South Africa: (A) hydrometeorological data (rainfall, streamflow, evaporation), (B) land use (irrigation, afforestation, reservoirs), (C) breakdown of tertiary catchments, (D) synthetic hydrology, (E) quaternary subcatchments, (F) storage requirements (flow duration-frequency plots, hydrological zones, evaporation loss, sediment yield), and (G) users guide to computer programs. (Cassar-PTT)
W86-01997

MAGNITUDE AND FREQUENCY OF FLOOD VOLUMES FOR URBAN WATERSHEDS IN LEON COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
M. A. Franklin.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4233, 1984. 20 p, 2 fig, 5 tab, 32 ref.

Descriptors: *Regression analysis, *Flood recurrence interval, *Rainfall-runoff, *Unit hydrograph, Data collections, *Leon County, *Florida.

Techniques are provided for estimating runoff magnitudes for urban-flow streams in Leon County, Florida, for recurrence intervals of 2, 5, 10, 25, 50, 100, and 500 years. Synthetic runoff volumes were generated by using a calibrated lumped-parameter rainfall-runoff model, pan evaporation data from Milton, Florida, and long-term unit rainfall records from Thomasville-Coolidge, Georgia, and Pensacola, Florida. The synthetic runoff volumes were used to develop station runoff-frequency relations which were used in multiple linear regression analyses to derive regional equations relating runoff to basin characteristics. The significant basin characteristic was impervious area. The average standard error of regression was + or - 16 percent for all recurrence intervals except the 2-year, + or - 18 percent and the 500-year + or - 17 percent. (USGS)
W86-02354

FLOODS OF APRIL 18, 1983 ON ST. THOMAS AND ST. JOHN, U.S. VIRGIN ISLANDS,
Geological Survey, San Juan, PR. Water Resources Div.
R. E. Curtis.
Available from OFSS, USGS, Box 25425 Lake-

wood, CO 80225. USGS Water-Resources Investigations Report 84-4184, 1984. 12 p, 6 fig, 1 tab, 4 ref.

Descriptors: *Flood flow, Flood frequency, Peak flow, Flood profiles, Excess rainfall, Flood damage, *U.S. Virgin Islands, *St. Thomas, *St. John.

The U.S. Virgin Islands of St. Thomas and St. John experienced the most intense rainfall event in recorded history on April 18, 1983. Rainfall intensities of 2.5 inches per hour, and more than 16 inches in 18 hours were recorded. Almost instantaneous runoff caused widespread flood near the coastlines of both islands. Parts of Charlotte Amalie in St. Thomas were inundated with 4 feet or more of mud and flood water. Harry S. Truman Airport was flooded for 2 days with 2 to 3 feet of ponded water. On St. John, rural areas near Guinea Gut, Fish Bay, and Coral Bay were flooded. (USGS)
W86-02362

GEOLOGIC AND HYDROLOGIC DATA COLLECTED DURING 1976-1984 AT THE SHEFFIELD LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE AND ADJACENT AREAS, SHEFFIELE, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
J. B. Foster, G. Garklavs, and G. W. Mackey.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 83-926, 1984. 261 p, 2 fig, 9 tab, 7 ref.

Descriptors: *Groundwater, *Geology, *Glacial soils, *Radioactive wastes, Waste disposal sites, *Illinois, Bureau County, Sheffield, Water quality.

Hydrogeologic studies were conducted at the low-level radioactive-waste disposal site near Sheffield, Illinois, from 1976-1984. Data in this report include water levels in wells, lake stages, inorganic, organic, and radiometric chemical analyses of ground and surface water, hydraulic conductivities of glacial materials, grain-size distribution, clay and carbonate mineralogy, and cation exchange capacities of the glacial materials. Also included are results of petrographic analyses, physical measurements of wells, stratigraphy and lithology of cores collected from test wells, and horizontal coordinates of wells. (USGS)
W86-02372

HYDROLOGY OF PRAIRIE DOG CREEK VALLEY, NORTON DAM TO STATE LINE, NORTH-CENTRAL KANSAS,
Geological Survey, Garden City, KS. Water Resources Div.
L. E. Stulliken.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4162, 1985. 49 p, 11 fig, 2 tab, 17 ref.

Descriptors: Hydrology, Steady-state model, Groundwater flow, Recharge, Discharge, Base flow, *Hydrogeology, Surface-groundwater relationships, Model studies, *Prairie Dog Creek Valley, *Kansas.

Development of water resources has been a major factor in the economy of Prairie Dog Creek valley in north-central Kansas. Releases from Norton reservoir to the Almena Irrigation District averaged 6,900 acre-feet per year during 1967-76. The number of irrigation wells increased from 4 to 147 during 1947-78. Ground water in the valley is derived mostly from the alluvial aquifer. The effects of irrigation on the aquifer are indicated by water-level changes. The water in storage increased from 130,000 to 136,000 acre-feet during 1947-78 due to recharge from surface-water irrigation. A steady-state model of the aquifer prior to irrigation (1947) indicated that most recharge was from precipitation (88 percent) and most discharge was to streams (54 percent) and evapotranspiration (26 percent). Although aquifer storage increased in this area, storage generally decreased in other areas of western Kansas. (USGS)
W86-02377

PHASE I SUMMARY AND PHASE II PLAN FOR COMPARING REGULATED WITH UNREGULATED STREAMFLOW IN THE YAKIMA RIVER AT UNION GAP, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02378

GAZATTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--MERRIMACK RIVER BASIN,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02381

TIME OF TRAVEL, WATER QUALITY, AND BED-MATERIAL QUALITY FOR THE CUYAHOGA RIVER WITHIN THE CUYAHOGA VALLEY NATIONAL RECREATION AREA, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02389

APPLICATION OF THE U.S. GEOLOGICAL SURVEY'S PRECIPITATION-RUNOFF MODELING SYSTEM TO THE PRAIRIE DOG CREEK BASIN, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-02390

SELECTED HYDROLOGIC DATA FOR THE SOUTH PLATTE RIVER THROUGH DENVER, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02391

SURFACE-WATER INFLOW TO PUGET SOUND, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02395

CALIBRATION PROCEDURE FOR A DAILY FLOW MODEL OF SMALL WATERSHEDS WITH SNOWMELT RUNOFF IN THE GREEN RIVER COAL REGION OF COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-02403

WATER RESOURCES OF THE COTTONWOOD WASH WATERSHED, UTE MOUNTAIN, UTE INDIAN RESERVATION, SOUTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
A. L. Geldon.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4027, 1985. 56 p, 13 fig, 10 tab, 48 ref.

Descriptors: Watersheds, Intermittent streams, *Alluvial aquifers, *Springs, *Water supply, *Water quality, Hydrologic budget, *Groundwater-surface water relations, *Colorado, Montezuma County, *Four Corners area, Ute Mountain, Ute Indian Reservation, Towaoc, Cottonwood Wash, Sleeping Ute Mountain.

Cottonwood Wash, near Towaoc, Colorado, is a 16-square-mile watershed with an estimated average annual precipitation influx of 14,600 acre-feet. Most of this water is consumed by evapotranspiration. Except for snowmelt in the spring months and infrequent rain storms, all flow in the wash is from springs issuing from talus, block rubble, alluvium, colluvium, and Mancos Shale. Flow is greatest during the spring months when the ground is saturated from snowmelt and least during the early fall when many springs cease flowing. Most of the water in the wash upstream from Towaoc is diverted to Cottonwood Reservoir. Springs in the wash downstream from Towaoc are distributary. Most of the water from these springs, however, seeps back into the alluvium. One of these springs supplies about 19 acre-feet of water per year to Towaoc. The cumulative flow from 17 springs and diffuse seepage was about 290 acre-feet in the 1982 water year. The quantity of recoverable water in the younger of two pediment deposits is about 2,000 to 4,000 acre-feet, depending on seasonal and yearly variations in precipitation. Estimated underflow from the wash in the 1982 water year was 740 acre-feet; estimated recharge to bedrock was 850 acre-feet. Water from block rubble and talus is suitable for most purposes; water from Mancos Shale and alluvium may contain concentrations of dissolved solids that are unacceptable for domestic use. (USGS)
W86-02404

STREAM DISCHARGE IN MICHIGAN--MISCELLANEOUS MEASUREMENTS,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02409

STATISTICAL MODELS FOR ESTIMATING FLOW CHARACTERISTICS OF MICHIGAN STREAMS,
Geological Survey, Lansing, MI. Water Resources Div.
D. J. Holtschlag, and H. M. Croskey.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4207, 1984. 80 p, 8 fig, 15 tab, 15 ref.

Descriptors: *Regression analysis, *Estimating equations, *Flow characteristics, River basins, Hydrometeorology, Average flow, Low flow, Duration curves, Peak discharge, Regional analysis, *Michigan, *Statistical models.

Multiple-regression equations provide statistical models to estimate flow characteristics at ungaged sites in Michigan. The equations require determination of several readily measureable basin and metereological characteristics and an areal adjustment factor. Flow characteristics for which estimating equations have been prepared include mean and mean monthly flow, flow-duration, low flow, peak discharge, and flood volume. The precision of the flow estimate varies with the flow characteristics being estimated and the basin characteristics have the lowest standard errors, whereas peak flow and low flow characteristics have the highest standard errors. Sites that have basin characteristics similar to the basin characteristics used to develop the regression equations can be estimated more precisely. Confidence limits can be computed about the estimates using information included in the report. Need for additional gaging stations is assumed to be proportional to the standard error of residuals found among five regions designated in Michigan. Additional continuous-record stations may be most beneficial in region 3 for reducing the standard error of mean and mean monthly flow equations. Additional partial-record stations may be useful in region 4 for reducing the standard error of low flow and peak flow estimates. (USGS)
W86-02411

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--HUDSON RIVER BASIN,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02416

PRAGMATIC APPROACH TO EVALUATING A MULTIPURPOSE STREAM-GAGING NETWORK,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02417

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--COASTAL RIVER BASINS OF THE NORTH SHORE,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02418

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--CONNECTICUT RIVER BASIN,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02419

2F. Groundwater

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, MAY 1985,
Geological Survey, Tampa, FL. Water Resources Div.
G. L. Barr.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-482, 1985. 1 p, 2 fig, 2 ref.

Descriptors: *Potentiometric level, Potentiometric flow, Hydrology, Hydrogeology, *Florida, *Maps.

A May 1985 potentiometric surface map of the Upper Floridan aquifer in west-central Florida depicts the annual low water-level period. Most areas of west-central Florida were experiencing drought conditions and water levels were at or approaching near-record low levels. Water levels in most wells measured in May 1985 were lower than in September 1985. May levels averaged about 5 feet lower than September levels in areas north of latitude 28 degrees 07' and about 13 feet lower in southern areas. Generally, water levels in May 1985 averaged about 4 feet lower than May 1984 levels in the north and about 6 feet lower in the south. (USGS)
W86-01920

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA,
Geological Survey, Lakewood, CO. Water Resources Div.
W. H. Langer, W. R. Moyle, L. R. Woolfender, and D. A. Mulvihill.
Available from OFSS, USGS BOX 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4116-B, 1983. 6 p, 3 fig, 40 ref.

Descriptors: *Groundwater levels, *Springs, Hydrogeology, *Groundwater data, Basin and Range province, *California.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the southern California part of the Basin and Range province. The first map, at a scale of 1:500,000, shows the approximate altitude of the water table, and the location, temperature, and flow of large springs. The altitude of the water table is shown by contours where sufficient data exists; otherwise it is shown by data points. Springs with flows of 10 gallons per minute or more have been mapped. A second map at a scale of 1:1,000,000 shows the depth to ground water and areas of basin fill or consolidated rocks. In areas where the depth to ground water is less than 500 feet, the depth is shown by lines of equal depth to water or data points where data are insufficient to draw lines. Areas are shaded where the depth to the water table is generally greater than 500 feet. (USGS)
W86-01921

GEOHYDROLOGY OF VOLCANIC TUFF PENETRATED BY TEST WELL UE-25BNO1, YUCCA MOUNTAIN, NYE COUNTY, NEVADA,
Geological Survey, Lakewood, CO. Water Resources Div.
R. G. Lahoud, D. H. Lobmeyer, and M. S. Whitfield.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4253, 1984. 44 p, 25 fig, 5 tab, 24 ref.

Descriptors: *Nevada, *Radioactive waste disposal, *Water levels, Hydrogeology, *Hydrologic properties, Igneous rocks, *Yucca Mountain, Nevada Test Site.

Test well UE-25bNo1, located on the east side of Yucca Mountain in the southwestern part of the Nevada Test Site, was drilled to a total depth of 1,220 meters and hydraulically tested as part of a program to evaluate the suitability of Yucca Mountain as a nuclear-waste repository. The well penetrated almost 46 meters of alluvium and 1,174 meters of Tertiary volcanic tuffs. The composite hydraulic head for aquifers penetrated by the well was 728.9 meters above sea level (471.4 meters below land surface) with a slight decrease in loss of hydraulic head with depth. Average hydraulic conductivities for stratigraphic units determined from pumping tests, borehole-flow surveys, and packer-injection tests ranged from less than 0.001 meter per day for the Tram Member of the Crater Flat Tuff to 1.1 meters per day for the Bullfrog Member of the Crater Flat Tuff. The small values represented matrix permeability of unfractured rock; the large values probably resulted from fracture permeability. Chemical analyses indicated that the water is a soft sodium bicarbonate type, slightly alkaline, with large concentrations of dissolved silica and sulfate. Uncorrected carbon-14 age dates of the water were 14,100 and 13,400 years. (USGS)
W86-01923

COMPUTER MODEL OF ONE-DIMENSIONAL EQUILIBRIUM CONTROLLED SORPTION PROCESSES,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01925

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1984,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-01926

HYDROGEOLOGY AND EFFECTS OF TAILINGS BASINS ON HYDROLOGY OF SANDS PLAIN, MARQUETTE COUNTY, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
N. G. Grannemann.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4114, 1984. 98 p, 31 fig, 21 tab, 32 ref.

Descriptors: *Hydrogeology, Groundwater recharge, Groundwater movement, Groundwater runoff, *Surface water - groundwater relationships, Obstruction to flow, Hydraulic conductivity, Leakage, Computer models, Marquette Iron Range, Marquette County, *Michigan.

A hydrogeological study of Sands Plain, a sandy outwash area in the north-central part of Michigan's Upper Peninsula, was conducted during 1979-82. Parts of the area are being considered as possible sites for construction and operation of iron mining tailings basins. Gribben Basin, an existing tailings basin in the western part of Sands Plains, covers 2.5 square miles; hypothetical tailings basins may cover as much as 11 square miles. Glacial deposits are the area's principal aquifer. The general direction of ground-water flow is from the outwash area toward Lake Superior. Before reaching Lake Superior, however, most ground water is discharged in a series of nearly parallel streams. Ground water accounts for 95 percent of the discharge of these streams. Precipitation collected at two sites had average pH values of 4.0. Dissolved solids concentrations in water from wells ranged from 41 to 246 milligrams per liter; in water from streams, they ranged from 82 to 143 milligrams per liter. Calcium and bicarbonate were the principal dissolved ions. A two-dimensional digital model of ground-water flow was used to simulate groundwater levels and runoff. The predictive computer simulations indicate that construction and operation of Gribben tailings basin, located in the western part of the study area, decreased ground-water flow to Goose Lake Outlet by 0.9 to 1.6 cubic feet per second. Construction and operation of four hypothetical tailings basins covering a total of 11 square miles is estimated to reduce ground-water flow to the area's streams by 7 to 18 cubic feet per second depending on the hydraulic properties of material comprising the basin boundaries. Leakage from all of the basins is estimated to range from 0.7 to 7 cubic feet per second. (USGS)
W86-01927

WATER RESOURCES AND EFFECTS OF DEVELOPMENT IN HERNANDO COUNTY, FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-01931

GROUND-WATER HYDROLOGY OF VOLUSIA COUNTY, FLORIDA, WITH EMPHASIS ON OCCURRENCE AND MOVEMENT OF BRACKISH WATER,
Geological Survey, Orlando, FL. Water Resources Div.
A. T. Rutledge.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4206, 1985. 84 p, 42 fig, 6 tab, 19 ref.

Descriptors: Brackish water, *Saltwater intrusion, *Drawdown, *Freshwater-saltwater interface, *Saline water intrusion, Path of pollutants, *Florida, Volusia County.

Brackish water is present in the eastern and western fringes of Volusia County, Florida in the surficial aquifer and in the Floridan aquifer system. Average pumpage in 1980 in Volusia County was 66 million gallons per day. Water levels in the Floridan aquifer system declined more than 10 feet over an area of 70 square miles from 1955 to 1982. The annual water budget of the budget of the Floridan aquifer system consists of 5 inches downward leakage inflow, 1 inch upward leakage outflow, 1 inch horizontal inflow, 1.5 inches horizontal outflow, 2.5 inches discharge from springs and flowing wells, and 1 inch pumpage. Saltwater intrusion is occurring in the surficial aquifer on the barrier island. There is little evidence that intrusion is occurring uniformly over large areas in the Floridan aquifer system. Vertical intrusion is occurring at sites of public-supply pumping. Many of these wells in the fringes of the county have been abandoned and replaced by wells closer to the central part of the county. Minimizing well depth is probably the single most effective step against intrusion. (USGS)
W86-01932

USE OF DOUBLE-MASS CURVES TO DETERMINE DRAWDOWN IN A LONG-TERM AQUIFER TEST IN NORTH-CENTRAL VOLUSIA COUNTY, FLORIDA,
Geological Survey, Orlando, FL. Water Resources

Div.
A. T. Rutledge.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4309, 1985. 29 p, 17 fig, 1 tab, 10 ref.

Descriptors: Drawdown, Aquifer test, Capture, Double-mass curve, Leakage, *Groundwater levels, Water yield, *Florida, Volusia County.

A test well withdrew water from the upper Floridan aquifer system at an average of 530 gallons per minute from June 1978 to July 1979. Ground-water levels were monitored in wells open to the upper Floridan (artesian) aquifer system and in wells open to the surficial (water-table) aquifer. Double-mass curves were used to separate drawdown from natural water-level fluctuations. Drawdowns in the Floridan were 4.3 feet at a site 350 feet away from the pumped well, 4.1 feet at a site 1,000 feet away, 1.0 foot at a site 1.0 mile away, and 0.4 foot at a site 5.8 miles away. After an initial drawdown of 0.2 foot at a surficial aquifer well 1,000 feet from the pumped well, there was some recovery, and long-term drawdown averaged less than 0.2 foot. In a five-day aquifer test during a period of no rainfall in 1976, the ratio of surficial aquifer drawdown to Floridan aquifer system drawdown reached equilibrum at 0.05. The results of the long-term test indicate that this ratio is the upper limit of long-term drawdown because of capture of evapotranspiration and runoff during the long-term test. (USGS)
W86-01933

WIRELINE-ROTARY AIR CORING OF THE BANDELIER TUFF, LOS ALAMOS, NEW MEXICO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-01934

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, BASIN AND RANGE PROVINCE, UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01938

MAP SHOWING OUTCROPS OF PRE-QUATERNARY ASH-FLOW TUFF AND LAHARIC BRECCIA, BASIN AND RANGE PROVINCE, NEW MEXICO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01939

OCCURRENCE OF SALINE WATER IN THE ALLUVIAL AQUIFER IN THE BOEUF-TENSAS BASIN, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01940

NITROGEN, SULFATE, CHLORIDE, AND MANGANESE IN GROUND WATER IN THE ALLUVIAL DEPOSITS OF THE SOUTH PLATTE RIVER VALLEY NEAR GREELEY, WELD COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01941

POTENTIOMETRIC MAP OF THE PALEOZOIC AQUIFER IN NORTHEASTERN MISSISSIPPI, NOVEMBER AND DECEMBER 1982,
Geological Survey, Jackson, MS. Water Resources Div.
D. Darden.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4254, 1984. 1 sheet, 3 fig, 6 ref.

Descriptors: *Potentiometric map, *Water level, Groundwater, Aquifers, Hydrogeology, *Mississippi, Paleozoic rock.

The Paleozoic rocks that outcrop in Tishomingo County, Mississippi, supply water to public, industrial, and domestic wells in two counties in the northeastern part of the State. Paleozoic rocks in the area consist mostly of beds of sandstone, shale, and limestone which dip about 30 feet per mile to the southwest. The potentiometric surface of the Paleozoic aquifer slopes generally to the west away from the area of outcrop and is strongly affected by large groundwater withdrawals at Corinth. The water level at Corinth has declined about 160 feet from 1954 to 1974 and recovered about 45 feet by 1982. Wells that were near the center of the cone of depression have been replaced by new wells located away from the center. (USGS)
W86-01942

POTENTIOMETRIC SURFACE MAP OF THE ALLUVIAL AQUIFER, EASTERN ARKANSAS, SPRING 1983,
Geological Survey, Little Rock, AR. Water Resources Div.
J. Edds, and D. J. Fitzpatrick.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4264, 1984. 1 sheet, 5 fig, 7 ref.

Descriptors: Potentiometric level, *Water level, Hydraulic gradient, *Arkansas, *Missippi River alluvial aquifer, *Arkansas County, *Poinsett County.

The Mississippi River Alluvial Aquifer is a major source of water supply for irrigation in much of eastern Arkansas. Hydrologic maps of the potentiometric surface, water-level changes and depths to water in the aquifer, based on Spring 1983 measurements, are presented. The Mississippi River Alluvial Aquifer is comprised of Quaternary alluvial flood-plain and terrace deposits. The aquifer generally is partially-confined. Recharge to the aquifer is principally through precipitation and surface-water bodies. The potentiometric surface map indicates two cones of depression occurring in the aquifer beneath Arkansas, Poinsett, and Cross Counties as a result of heavy pumpage within these areas. A comparison of water-level data from 1982 and 1983 shows water levels in the aquifer generally decreasing in the area within the cones of depression. Water levels generally increased in the remainder of the area south and west of the White River, and along the Mississippi River. A map showing the depth to water below land surface indicates that water levels are generally shallowest near the Mississippi River and the Fall Line and deepest within the cone of depression. (USGS)
W86-01943

POTENTIOMETRIC SURFACE MAP OF THE SPARTA SAND AND MEMPHIS SAND AQUIFERS IN EASTERN AND SOUTH-CENTRAL ARKANSAS, SPRING 1983,
Geological Survey, Little Rock, AR. Water Resources Div.
J. Edds, and D. J. Fitzpatrick.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4265, 1984. 1 sheet, 3 fig, 5 ref.

Descriptors: *Potentiometric level, *Groundwater levels, Groundwater, Water levels, *Arkansas, *Sparta Sand aquifer, *Memphis Sand aquifer.

The Sparta Sand and the Memphis Sand aquifers are a major source of industrial and public water supply and a minor but locally significant source of water for agricultural purposes in eastern and south-central Arkansas. The potentiometric surface map for this aquifer, compiled from water-level measurements made during the spring of 1983, indicates a generally southward potentiometric gradient. The potentiometric surface also illustrates the existence of three major cones of depression; one centered in Columbia County, one in Union County, and one in Jefferson County. Within the cones of depression, the majority of water withdrawn is utilized for industrial and public supply. The water-level change map for the Sparta Sand and the Memphis aquifer for the period between the springs of 1982 and 1983 shows overall a rise in water levels across the study area, including the cones of depression in Jefferson and Union Counties; however, water levels within the cone depression in Columbia County generally declined. (USGS)
W86-01944

MAP SHOWING OUTCROPS OF THICK, DOMINANTLY ARGILLACEOUS SEDIMENTARY AND METASEDIMENTARY ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01945

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01946

MAP SHOWING OUTCROPS OF PRE-QUATERNARY BASALTIC ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01947

MAP SHOWING OUTCROPS OF THICK, DOMINANTLY AGRILLACEOUS SEDIMENTARY AND METASEDIMENTARY ROCKS, BASIN AND RANGE PROVINCE, UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01948

GROUND-WATER DATA FOR MICHIGAN--1983,
Geological Survey, Lansing, MI. Water Resources Div.
G. C. Huffman.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-623, 1984. 47 p, 5 fig, 2 tab, 100 ref.

Descriptors: *Water resources, *Groundwater, *Groundwater hydrographs, Water levels, Water use, Water quality, *Michigan.

Water levels, locations, depths, and aquifers tapped are given for 115 observation wells in Michigan. Tabulated data include extremes of water levels for 1983 and for the period of record, pumpage of most major ground-water users in the state and quality data on selected wells. The largest reported user of ground water, the city of Lansing, pumped 8.1 billion gallons from the Saginaw Formation and glacial deposits. (USGS)
W86-01950

OCCURRRENCE OF BEDS OF LOW HYDRAULIC CONDUCTIVITY IN SURFICIAL DEPOSITS OF FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. G. Healy, and J. D. Hunn.
Available from OFSS, USGS Box 25425. USGS Water-Resources Investigations Report 84-4210, 1984. 1 p, 1 fig, 1 tab, 59 ref.

Descriptors: Permeability coefficient, *Hydrologic maps, Infiltration, Percolation, *Groundwater, *Geohydrology, *Florida.

The disposal of municipal and industrial wastes on or at shallow depths below land surface can result in contamination of ground water--the source of

drinking water for more than 90 percent of Florida's residents. This threat to public health has resulted in new State groundwater regulations. Knowledge of the ability of surficial deposits to retard movement of contaminants is important to the implementation of these regulations. This map report shows areas where beds of at least 10 feet thickness with a hydraulic conductivity (saturation) of less than 0.1 foot per day occur within 50 feet below land surface, based mainly on interpretations of lithology. The map is intended as a guide for making preliminary assessments and should not be considered definitive of permeability beneath a specific site. Available determinations of hydraulic conductivities of surficial deposits in Florida are shown in table format. (USGS)
W86-01951

HYDROGEOLOGIC DATA FROM PARTS OF THE DENVER BASIN, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
T. J. Major, S. G. Robson, J. C. Romero, and S. Zawistowski.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-274, 1983. 425 p, 7 fig, 13 tab, 111 ref.

Descriptors: *Aquifers, *Groundwater, *Hydrogeologic data, Surface water, Water quality, *Colorado, *Denver basin.

This report presents hydrogeologic data collected and compiled during 1956-81 as part of a comprehensive hydrogeologic data collected and compiled during 1956-81 as part of a comprehensive hdryogeologic investigation of the Denver basin, Colorado, by the U.S. Geological Survey in cooperation with the Colorado Department of Natural Resources, Division of Water Resources, Office of the State Engineer. The data, in tabular and graphic form, consist of records for 870 wells which include water-level data for 158 wells and water-quality analyses for 561 wells; geophysical logs from three wells which include resistivity, self potential, and natural gamma logs; and gain-and-loss data of streamflow measured at 54 sites. (USGS)
W86-01952

GROUND-WATER-QUALITY MONITORING NETWORK DESIGN FOR THE SAN JOAQUIN VALLEY GROUND-WATER BASIN, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-01953

GROUND-WATER RESOURCES OF LANFAIR AND FENNER VALLEYS AND VICINITY, SAN BERNARDINO COUNTY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
D. A. Freiwald.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4082, 1984, 78 p, 4 fig, 4 tab, 10 ref.

Descriptors: Wells, Springs, *Water Quality, Well logs, Geology, Hydrology, Well yield, Precipitation, *Groundwater, Surface water, Water supply, Water yield, *California, Fenner, Lanfair, San Bernadino County.

Lanfair and Fenner Valleys and vicinity cover about 1,300 square miles in eastern San Bernardino County, California. Average annual precipitation ranges from 3 to 10 inches over the area. Ground water is utilized primarily for stock and domestic purposes, and occurs in the unconsolidated deposits as well as in the highly fractured consolidated rock. Ground-water levels in wells range from 5 to 600 feet below land surface, and well yields range from 3 to 1,200 gallons per minute throughout the study area. Records indicate that water levels are at or near their predevelopment levels. Springs occur along faults and formational contacts and generally discharge less than 5 gallons per minute. Measured ground-water outflow from Lanfair Valley at Piute Spring ranged from 100 to 630 acre-feet per year. Most of the water is of good quality for domestic and stock use. However, water from two wells indicates a concentration of sulfate that is above the recommended limit for drinking water. Water supplies are adequate for present needs. However, large-scale pumping would result in the lowering of the water table and a reduction of the ground water in storage. (USGS)
W86-01955

IRRIGATION DATA FROM CHASE, DUNDY, AND PERKINS COUNTIES, NEBRASKA,
Geological Survey, Lakewood, CO. Water Resources Div.
D. M. Stephen, F. J. Heimes, and R. R. Luckey.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-471, 1984. 31 p, 2 fig, 12 tabs, 5 ref.

Descriptors: *Pumpage, Ground-water irrigation, *Discharge measurement, High Plains, *Nebraska, Chase, Dundy, Perkins, Clampitron, Irrigation water, Water supply, Data collections, Hydrologic data.

This report summarizes data collected by the U.S. Geological Survey in Chase, Dundy, and Perkins Counties, southwest Nebraska. It includes data collected from 52 randomly selected wells that were monitored during the 1983 irrigation season to obtain measurements of discharge and the rate of energy consumption. The data were collected as part of a study to better define the relationship between pumpage and return flow from applied water. (USGS)
W86-01957

JANUARY 1984 WATER LEVELS, AND DATA RELATED TO WATER-LEVEL CHANGES, WESTERN AND SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
M. E. Pabst, and B. J. Dague.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-613, 1984. 163 p, 2 fig, 1 tab, 15 ref.

Descriptors: *Groundwater, Water-level changes, *Hydrologic data, *Kansas, Data collections.

Water-level measurements were made, mostly during January 1984, in about 1,450 wells in western and south-central Kansas. The measurements were made in mid-winter when pumping was minimal and water levels had recovered, for the most part, from the effects of pumping during the previous irrigation season. Annual hydrologic data are provided for relating water-level changes from a 'base-reference year' (predevelopment year), a year of abnormally high rainfall and minimum pumpage (1966 or 1974), and each of 7 consecutive years of measurement (1978-84). The 'base-reference year' is designated as 1940 for the southwestern area, 1944 for the south-central area, and 1950 for the northwestern and west-central areas. Water levels for the 'base-reference year' are established by measurements made during that year and by interpretation of maps showing water-level altitudes. Data also are provided for relating the average annual water-level changes, saturated thicknesses of the deposits, and percentage changes in saturated thicknesses.
W86-01960

AVAILABILITY AND CHEMISTRY OF GROUND WATER ON THE BRUNEAU PLATEAU, SOUTH-CENTRAL IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
R. L. Moffatt, and M. L. Jones.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4065, 1984. 88 p, 15 fig, 7 tab, 31 ref.

Descriptors: Available groundwater, Available water, *Ground-water availability, *Groundwater irrigation, Available irrigation water, Bruneau plateau, *Idaho, *Groundwater chemistry.

The Bruneau plateau in south-central Idaho consists of about 889,600 acres of potentially irrigable land. About 112,200 of these acres have been developed for agriculture; 11,200 acres are irrigated with ground water, and the remaining acreage is irrigated with water from the Snake and Bruneau rivers and Salmon Falls Creek. On the basis of present usage, about 158,000 acre-feet of water per year are needed to develop an additional 63,000 acres. About 438,000 acre-feet per year are needed to irrigate existing and newly developed lands in dry years when streamflow in the Snake River at Milner Dam is inadequate to meet appropriated needs. Pumping lifts of about 400-600 feet and low well yields on the Bruneau plateau probably preclude large-scale irrigation development solely from local ground-water resources. However, supplemental sources of irrigation water are available from a perched-water aquifer, a thermal aquifer, and the regional aquifer adjacent to the plateau. About 100,000-115,000 acre-feet per year of water probably could be withdrawn from the perched and regional aquifers and conveyed to the plateau without serious impact on local ground-water resources. The amount of water that could be safely withdrawn from the thermal aquifer was not determined. (USGS)
W86-01963

GROUND-WATER LEVEL DATA AND PRELIMINARY POTENTIOMETRIC-SURFACE MAPS, YUCCA MOUNTAIN AND VICINITY, NYE COUNTY, NEVADA.
Geological Survey, Lakewood, CO. Water Resources Div.
J. H. Robison.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4197, 1984. 20 p, 2 fig, 1 tab, 2 ref.

Descriptors: *Ground-water level, *Potentiometric level, Hydrologic maps, *Nevada, Nye County, Yucca Mountain, Hydrologic data.

The report contains a table of ground-water level data and two preliminary potentiometric-surface maps for the Yucca Mountain area. The water-level surface shown on the maps generally represents water-table (unconfined) conditions. The water table in the Yucca Mountain area occurs in ash-flow and air-fall tuffs of tertiary age. West of the crest of Yucca Mountain, water-level altitudes are about 775 meters above sea level. Along the eastern edge and southern end of Yucca Mountain, the potentiometic surface generally is nearly flat, is about 728 to 730 meters above sea level, and has a southeastward slope. (USGS)
W86-01964

ASSESSMENT OF WATER RESOURCES AT FORT CARSON MILITARY RESERVATION NEAR COLORADO SPRINGS, COLORADO,
Geological Survey, Pueblo, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-01969

GEOCHEMICAL PROCESSES IN THE GASCOYNE LIGNITE MINING AREA, BOWMAN COUNTY, NORTH DAKOTA,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01970

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, ARIZONA,
Geological Survey, Lakewood, CO. Water Resources Div.
W. H. Langer, D. A. Mulvihill, and T. W. Anderson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-B, 1984. 7 p, 3 fig, 41 ref.

Descriptors: *Groundwater levels, *Springs, Aquifers, Maps, *Basin and Range province, *Arizona.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Arizona part of the Basin and Range province. The first map, at a scale of 1:500,000, shows the approximate altitude of the ground-water table, and the location, temperature, and flow of large springs. The altitude of the ground-water table is shown by contours where sufficient data exists; otherwise it is shown by data points. Springs with flows of 10 gallons per minute or more have been mapped. A second map at a scale of 1:1,000,000 shows the depth to ground water and areas of basin fill or consolidated rocks. In areas where the depth to ground water is less than 500 feet, the depth is shown by lines of equal depth to ground water or data points where data are insufficient to draw lines. Areas are shaded where the depth to the ground water table is generally greater than 500 feet. (USGS)
W86-01971

MAP SHOWING OUTCROPS OF PRE-QUATERNARY ASH-FLOW TUFFS AND VOLCANICLASTIC ROCKS, BASIN AND RANGE PROVINCE,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01972

MAP SHOWING OUTCROPS OF GRANITIC ROCKS AND PRE-QUATERNARY ASH-FLOW TUFFS, BASIN AND RANGE PROVINCE, OREGON,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01973

MAP SHOWING OUTCROPS OF PRE-QUATERNARY BASALTIC ROCKS, BASIN AND RANGE PROVINCE, OREGON,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01974

SURFACE WATER RESOURCES OF SOUTH AFRICA; VOLUME I: DRAINAGE REGIONS A, B-THE LIMPOPO-OLIFANTS SYSTEM,
University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit.
For primary bibliographic entry see Field 2E.
W86-01990

SURFACE WATER RESOURCES OF SOUTH AFRICA; VOLUME IV: DRAINAGE REGIONS E, G, H, J, K, L - THE WESTERN CAPE,
University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit.
For primary bibliographic entry see Field 2E.
W86-01997

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN GROUNDWATER MODELING: SELECTION, TESTING AND USE,
Michigan Dept. of Natural Resources, Lansing.
D. A. Hamilton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-143214, Price codes: A08 in paper copy, A01 in microfiche. Volume 2: Appendices, September 1982. 174 p.

Descriptors: *Groundwater management, *Models, *Aquifers, *Groundwater movement, *Groundwater pollution, Model studies, Path of pollutants, Fate of pollutants, Landfills, Hydrologic models, Finite element method, Mathematical models.

This volume is comprised of four appendices. The first describes an assessment of the two-dimensional flow model at the Southwest Ottawa County Landfill. The two-dimensional methodology used at the site should be applicable to similar sites. The second appendix describes an investigation of contaminant transport parameters in Michigan Aquifers. The third appendix discusses aquifer dispersivities from field data with examples of contaminant transport in Michigan aquifers. The fourth appendix deals with a groundwater management strategy for Michigan using finite-element modelling of contaminant transport. The strategy uses the finite element groundwater/transport model GEOFLOW. The utility and accuracy of GEOFLOW is demonstrated by comparison with an analytical solution and by modeling an idealized flow situation. Further refinement of GEOFLOW would be achieved by delineating a more localized flow region effecting a smaller grid and accompanying Peclet number. (Geiger-PTT)
W86-02034

RELATIONSHIP OF LABORATORY AND FIELD DETERMINED HYDRAULIC CONDUCTIVITY IN COMPACTED CLAY SOILS,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
A. S. Rogowski, and E. B. Richie.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 520-533, 2 fig, 25 ref.

Descriptors: *Liners, *Clays, *Permeability coefficient, *Field tests, *Design criteria, *Soil mechanics, Fluid mechanics, Membranes, Soil types, Models, Infiltration, Infiltrometers, Hydrologic properties, Thermodynamics, Soil properties.

When soil is to be used as a liner material, accurate soil properties should be obtained by simple, rapid, and reliable methods across a grid or transect sampling area. Field measurements of soil hydrological properties are often time consuming and are being replaced by models of water retention (Brooks and Corey) and the Green and Ampt infiltration equation. The high variability of scale models may be bypassed by measuring hydrological properties at a larger scale. Another attractive approach for evaluating a potential performance of clay liners is the use of scaling theory based on the concepts of similar media. Scaling factors can be obtained from readily available infiltration parameters. In swelling systems, the effect of gravity on flow will be less or nonexistent, and vertical moisture profiles are likely to vary depending on clay thickness and location with respect to the water table. Fluid mechanics and thermodynamics have been used to predict the behavior of swelling soils. Soil structure, aggregate stability, and dispersion may also influence hydraulic conductivity. Hydraulic conductivity is generally evaluated at high gradients to shorten time needed to obtain results. The ring infiltrometer test for infiltration and measurements of macroporosity by the clothier and White infiltrometer are described along with design criteria for determining the hydrologic behavior of clay liners. (Geiger-PTT)
W86-02119

LOCATING THE GROUNDWATER POLLUTION SOURCES USING COMPUTER MODELS,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-02121

SIMULATED EFFECTS OF AN ARTIFICIAL-RECHARGE EXPERIMENT NEAR PROCTOR, LOGAN COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02344

QUALITY OF GROUND WATER IN THE PRINCIPAL AQUIFERS OF NORTHEASTERN-NORTH CENTRAL WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02345

PRELIMINARY ANALYSIS OF GEOHYDROLOGIC DATA FROM TEST WELLS DRILLED NEAR CHESTER, ON KENT ISLAND, QUEEN ANNES COUNTY, MARYLAND,
Maryland Dept. of Natural Resources, Annapolis.
For primary bibliographic entry see Field 5A.
W86-02349

WATER RESOURCES OF THE RATTLESNAKE BUTTE AREA, A SITE OF POTENTIAL LIGNITE MINING IN WEST-CENTRAL, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
W. F. Horak.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4228, 1983. 53 p, 23 fig, 3 tab, 23 ref.

Descriptors: *Aquifers, *Groundwater, *Surface water, *Water chemistry, *Lignite, *Strip mines, Observation wells, Test holes, Belfield, Dickinson, South Heart, *North Dakota.

The D and E lignite beds, the two mineable beds in the lower Sentinel Butte Member (Fort Union Formation), underlies the entire Rattlesnake Butt study area, North Dakota but are unsaturated over much of their area of occurrence. Ground-water flow in both lignite aquifers is largely controlled by topography. Interconnected sand beds form aquifers between the E and D beds (E-D aquifer) and below the D bed (D-HT aquifer). Both aquifers underlie the central part of the study area and consist of fine silty sand. Depth to the aquifers is as much as 320 feet. Aquifers also occur in strata of Late Cretaceous and early Tertiary age. Aquifers in the Fox Hills Sandstone (Cretaceous) and lower Tongue River Member (Tertiary) lie at depths of about 1,700 and 750 feet, respectively. All aquifers yield a sodium bicarbonate or sodium sulfate type water. Mean dissolved-solids concentrations in the four shallowest aquifers ranged from 1,290 to 1,970 milligrams per litter. North Creek and an unnamed tributary of Green River drain most of the study area. North Creek, the major drain, ceases to flow during several months of most years, while the Green River tributary, with a smaller basin area, has sustained base flows of 0.15 to 0.25 cubic foot per second. Mining-induced impacts on the shallow ground-water flow system would be very localized because of the already low water levels and the segmented nature of the flow system in the lignite aquifers. (USGS)
W86-02350

GROUND-WATER HYDROLOGY OF THE SEVIER DESERT, UTAH, WITH RESULTS OF DIGITAL-COMPUTER MODELING,
Geological Survey, Salt Lake City, UT. Water Resources Div.
W. F. Holmes.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. Issued as Utah Department of Natural Resources Technical Publication 79, and USGS Open-File Report 83-0432, 1984. 59 p. 20 fig, 2 tab, 36 ref.

Descriptors: Water resources, *Utah, Great Basin, *Hydrology, Recharge, Storage, Evapotranspiration, *Water quality, *Model studies, *Sevier Desert, *Finite-difference models, Model predictions.

Changes in ground-water withdrawals, water levels, and quality of water occurred in the artesian aquifers of the Sevier Desert, Utah during 1963-81. Ground-water withdrawals increased from an average of 9,500 acre-feet (11.7 cubic hectometers) per year between 1951 and 1963 to an average of 27,500 acre-feet (33.9 cubic hectometers) per year between 1964 and 1981. Most of the increased withdrawal was from the deep artesian aquifer. Water levels declined as much as 19 feet (5.8 meters) in the deep artesian aquifer and as much as 13 feet (4.0 meters) in the shallow artesian aquifer

between 1963 and 1981. The declines probably are due to increased ground-water withdrawals for irrigation and municipal use. Quality of water in parts of the shallow artesian aquifer is deteriorating. The deterioration probably is the result of recharge of poor quality from the overlying water-table aquifer. A digital-computer model was constructed to predict water-level changes resulting from changes in recharge and discharge for 20 years (1981-2000) at one-half, one, and two times the 1977-79 average rate. The model computer water-level declines of more than 80 feet (24 meters) in the deep artesian aquifer with withdrawals twice the 1977-79 average, declines of more than 40 feet (12 meters) if withdrawals were equal to the 1977-79 average, and declines of more than 15 feet (4.6 meters) if withdrawals were one-half the 1977-79 average. Computer water-level declines after 20 years in the shallow artesian aquifer were more than 50 feet (15 meters) at two times the 1977-79 average rate, more than 15 feet (4.6 meters) at the 1977-79 average, and less than 4 feet (1.2 meters) at one-half the 1977-79 average. The model also was used to predict the effects of approximate changes in ground-water withdrawals related to the Intermountain Power Project. Water-level declines in the deep artesian aquifer of more than 15 feet (4.6 meters), and only small changes in water levels in the shallow artesian aquifer after 20 years. These changes are in addition to changes computed for 20 years of withdrawals at the 1977-79 rate. (USGS)
W86-02351

EVALUATION OF THE GROUND-WATER RESOURCES OF COASTAL GEORGIA: PRELIMINARY REPORT ON THE DATA AVAILABLE AS OF JULY 1983,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02352

PRELIMINARY STUDY OF THE AQUIFERS OF THE LOWER MESILLA VALLEY IN TEXAS AND NEW MEXICO BY MODEL SIMULATION,
Geological Survey, Austin, TX. Water Resources Div.
J. S. Gates, D. E. White, and E. R. Leggat.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4317, 1984. 21 p, 6 fig, 9 ref.

Descriptors: *Groundwater, Groundwater basins, Groundwater movement, Model studies, Hydrologic models, Transmissivity, Specific yield, Storage, Well spacing, Aquifers, Aquifer characteristics, *Texas, El Paso, Juarez, Rio Grande, Groundwater modeling.

The aquifers in the lower Mesilla Valley of Texas and New Mexico provide water for irrigation, industrial use, and municipal supply. The shallow aquifer principally is used for irrigation. The medium-depth aquifer and deep aquifer are used by the city of El Paso for municipal supply, about 120,000 acre-feet per year in 1975. The potential use of the medium-depth and deep aquifers for irrigation, together with a planned increase in pumping by the city, is causing concern about the impact of this development. A three-dimensional digital model of the aquifers was developed to evaluate the responses of water levels to various schemes of development, with particular emphasis on the medium-depth and deep aquifers in and near the Canutillo well field. The model simulations indicate that if pumpage increases to 10,000 acre-feet per year from the medium-depth aquifer and to 20,000 acre-feet per year from the deep aquifer, and elsewhere is constant, then additional lowering of water levels would be as much as 24 feet in the medium-depth aquifer and as much as 52 feet in the deep aquifer. The water levels would decline sharply during the first few months, after which the levels would become nearly stable because the leakage between the aquifers probably is enough to balance the increased pumpage. The model also indicated that lining of the channel of the Rio Grande would result in an additional lowering of water levels by 10 feet in the medium-depth aquifer and 8 feet in the deep aquifer. (USGS)
W86-02353

ILLINOIS GROUND-WATER OBSERVATION NETWORK - A PRELIMINARY PLANNING DOCUMENT,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02355

APPRAISAL OF THE SURFICIAL AQUIFERS IN THE POMME DE TERRE AND CHIPPEWA RIVER VALLEYS, WESTERN MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
W. G. Soukup, D. C. Gillies, and C. F. Myette.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4086, 1984. 63 p, 26 fig, 15 tab, 37 ref.

Descriptors: *Outwash, *Aquifers, *Irrigation wells, *Streamflow depletion, Model studies, *Surface-groundwater relationships, *Minnesota, *Pomme de Terre River, *Chippewa River, Analytical model, Finite-difference models, Transient calibration.

The surficial outwash aquifer along the Pomme de Terre and Chippewa Rivers, Minnesota is as thick as 100 feet and has a maximum transmissivity of 35,000 feet squared per day. An analytical model of a 50-mile reach of the Pomme de Terre River valley indicates that the 43 existing irrigation wells pumping at maximum potential yields could reduce streamflow 77 cubic feet per second which exceeds low base flow of the river. Results from a finite-difference model of the Appleton area indicate that pumping lowered ground-water levels as much as 3 feet from 1973-80 and reduced streamflow 14 cubic feet per second. Simulation of increased irrigation pumping and decreased areal recharge during a three-year drought indicates that water levels may decline 9 feet and streamflow may be reduced 41 cubic feet per second. When results of the analytical and finite-difference models are combined, computed streamflow reductions exceed available base flow by as much as 60 cubic feet per second. Results from a finite-difference model of the Benson area indicate that at maximum hypothetical development, drought conditions and increased irrigation pumping may lower water levels 12 feet and reduce flow in the Chippewa River 30 cubic feet per second, which is less than low base flow. (USGS)
W86-02357

RECORDS OF SELECTED WELLS, ST. MARYS AND CALVERT COUNTIES, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02359

MASS WATER-LEVEL MEASUREMENTS OF FALL 1984 IN THE CENTRAL PLATTE RIVER BASIN, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02360

GROUND-WATER CONDITIONS AND WELL YIELDS IN FRACTURED ROCKS, SOUTHWESTERN NEVADA COUNTY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
R. W. Page, P. W. Anttila, K. L. Johnson, and M. J. Pierce.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4262, 1984. 38 p, 12 fig, 11 tab, 14 ref.

Descriptors: *Groundwater, *Well yield, Fractured rocks, Groundwater use, Saturated fracture zones, Recharge, Lineations, Groundwater discharge, Grass Valley, Nevada County, *California.

This report describes the availability of ground water in the southwestern part of Nevada County, and suggests general guidelines for selecting sites for future ground-water development in the study area. Ground water in this area occurs chiefly in fractures in hard pre-Tertiary metavolcanic and plutonic rocks generally above a depth of 215 feet. Some ground water is found at the contact between alluvium or decomposed granite and the underlying hard rock; little is found in alluvium or colluvium. Mean yield is less than 18 gallons per minute. (USGS)
W86-02364

CHEMICAL AND ISOTOPIC CHARACTERISTICS OF BRINES FROM THREE OIL- AND GAS-PRODUCING FORMATIONS IN EASTERN OHIO, WITH APPLICATIONS TO THE GEOCHEMICAL TRACING OF BRINE SOURCES,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02365

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE OF PROVINCE, TEXAS,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02366

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, TEXAS,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02367

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02368

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02369

HYDROGEOLOGY OF A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE NEAR SHEFFIELD, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
J. B. Foster, J. R. Erickson, and R. W. Healy.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4125, 1984, 83 p, 48 fig, 7 tab, 23 ref.

Descriptors: *Groundwater, *Glacial soils, *Radioactive wastes, *Tritium migration, Geology, Hydrology, Hydraulic conductivity, Groundwater flow model, Path of pollutants, *Illinois, Waste disposal sites, US Ecology Company, Inc., Sheffield facility.

The Sheffield low-level radioactive-waste facility is located on 20 acres of rolling terrain 3 miles southwest of Sheffield, Illinois. The shallow hydrogeologic system is composed of glacial sediments. Pennsylvania shale and mudstone bedrock isolate the regional aquifers below from the hydrogeologic system in the overlying glacial deposits. Pebbly sand underlies 67 percent of the site. Two ground-water flow paths were identified. The primary path conveys ground water from the site to the east through the pebbly-sand unit; a secondary path conveys ground water to the south and east

through less permeable material. The pebbly-sand unit provides an underdrain that eliminates the risk of water rising into the trenches. Digital computer model results indicate that the pebbly-sand unit controls ground-water movement. Tritium found migrating in ground water in the southeast corner of the site travels approximately 25 feet per year. A group of water samples from wells which contained the highest tritium concentrations had specific conductivities, alkalinities, hardness, and chloride, sulfate, calcium, and magnesium contents higher than normal for local shallow ground water. (USGS)
W86-02371

GROUND-WATER QUALITY DATA FOR THE ATLANTIC COASTAL PLAIN: NEW JERSEY, DELAWARE, MARYLAND, VIRGINIA, AND NORTH CAROLINA,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02374

GROUND-WATER DATA FOR GEORGIA, 1984,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02376

HYDROLOGY OF PRAIRIE DOG CREEK VALLEY, NORTON DAM TO STATE LINE, NORTH-CENTRAL KANSAS,
Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02377

HYDROLOGY OF AREA 60, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, NEW MEXICO, COLORADO, UTAH, AND ARIZONA,
Geological Survey, Albuquerque, NM. Water Resources Div.
F. E. Roybal.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-203, 1983. 80 p, 47 fig, 9 tab, 54 ref.

Descriptors: Coal mining, Surface water, Groundwater, *Water quality, *Geohydrology, Land use, Observation wells, Water level, Streamflow variability, Erosion, Sedimentation, *Water pollution sources, *New Mexico, *Colorado, *Utah, *Arizona, *Delores River basin, *San Juan River basin.

An expansion of coal-mining activity is planned for Coal Area 60, which is one of 20 hydrologic reporting areas in the Northern Great Plains and Rocky Mountain Coal Provinces. Coal Area 60 includes approximately 20,000 square miles and is located at the southern end of the Rocky Mountain Coal Province in northwestern New Mexico, southwestern Colorado, southeastern Utah, and northeastern Arizona. Area 60 includes parts of the Dolores and San Juan River basins. Water-quality characteristics are based on data from 67 surface-water stations and 49 ground-water stations. Dissolved-solids concentrations in perennial rivers such as the San Juan River commonly are less than 500 milligrams per liter. Dissolved-solids concentrations of 2,000 milligrams per liter or more are present in the flows of ephemeral channels such as the Chaco River. Calcium and bicarbonate ions are the predominant ions in headwater flows, whereas sodium and sulfate ions become increasingly more dominant in the downstream direction. Concentrations of dissolved iron, manganese, and other trace elements in surface water generally are less than the limits set in drinking-water and mining regulations; however, the total recoverable concentrations from water-sediment mixtures may exceed these limits. Suspended sediment concentrations exceeding 10,000 milligrams per liter are present in the flow of arroyos that drain areas with sparse vegetation. The chemical-quality characteristics of ground water are similar to those of surface water except that the dissolved-solids concentration in ground water from all formations, especially shale deposits, may exceed 3,000 milligrams per liter. Sulfate concentrations are small in the ground water associated with coal deposits. Large concentrations of fluoride are present in ground water from all formations; large concentrations of lead, selenium and nitrate are associated with certain formations. Large alkalinity concentrations are found in the surface waters and ground waters of Area 60. (USGS)
W86-02382

GEOLOGY OF THE SURFICIAL AQUIFER SYSTEM, BROWARD COUNTY, FLORIDA,
Geological Survey, Miami, FL. Water Resources Div.
C. R. Causaras.
Available from OFSS, USGS, Box 25425. Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4068. 1985. 2 pl, 9 fig, 9 ref.

Descriptors: *Geologic formations, *Cross sections, *Hydrology, Carbonate aquifers, Unconfined aquifer, *Forida, Broward County, *Biscayne aquifer.

The geologic framework of the surficial aquifer system, of which the Biscayne aquifer is the major component in Broward County, Florida, is presented in eight geologic cross sections. The cross sections are based on detailed lithologic logs of 27 test wells that were drilled, in the summer of 1981, through the sediments overlying the relatively impermeable units of the Hawthorn Formation, of Miocene age. The cross sections show the aquifer system as a wedge-shaped sequence of Cenozoic sediments. The aquifer thickness gradually decreases from more than 400 feet along the coast to about 160 feet in the west and southwest parts of Broward County. The sediments that comprise the aquifer system range in age from Pliocene to Pleistocene and are assigned to the following stratigraphic units from bottom to top: Tamiami Formation, Caloosahatchee Marl, Fort Thompson Formation, Key Largo Limestone, Anastasia Formation, Miami Oolite, and Pamlico Sand. (USGS)
W86-02383

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, NEVADA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02384

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, NEVADA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02385

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, ARIZONA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02386

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02387

DELINEATION AND DESCRIPTION OF A ZONE OF HIGHER SECONDARY PERMEABILITY IN THE SURFICIAL AQUIFER OF EASTERN PALM BEACH COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. J. Swayze, and W. L. Miller.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4249, 1984. 39 p, 22 fig, 5 tab, 30 ref.

Descriptors: *Groundwater, Water quality, Geology, *Florida, *Hydrogeology, Aquifers, *Permeability, Saline water intrusion, Palm Beach County, Aquifer characteristics, *Secondary permeability.

The surficial aquifer is the primary source of freshwater for the heavily developed coastal area in eastern Palm Beach County, Florida. Well fields are generally located in a discontinuous zone of higher secondary permeability, the northernmost extension of the Biscayne aquifer in the surficial aquifer, that extends from the Juno Beach area south to Broward County and varies in width from about 4 to 15 miles. The zone was formed by varying dissolution of aquifer limestone materials during Pleistocene age changes in sea level, and ranges in depth from about sea level to 220 feet below sea level. Because of proximity to the Atlantic Ocean and saltwater estuaries, the aquifer is susceptible to saltwater intrusion. Ground water to the west of the zone of higher secondary permeability is of poor quality. The ground water is calcium bicarbonate dominant. Dissolved solids, calcium carbonate hardness, and chloride are greatest along the saltwater intruded coastline and in the western part of the study area where diluted residual seawater exists. Total organic carbon increases inland due to infiltration of rainwater through thicker layers of organic soils. Groundwater levels in the surficial aquifer in eastern Palm Beach County are strongly influenced by controlled levels in canals. In March 1981, after 12 months of below average rainfall, ground-water levels ranged from about 2 feet above sea level along the coast to nearly 21 feet above sea level 15 miles inland in the northwest section of the study area. (USGS)
W86-02393

ALDICARB-PESTICIDE CONTAMINATION OF GROUND WATER IN EASTERN SUFFOLK COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02394

GEOHYDROLOGIC RECONNAISSANCE OF THE AVOCA LIGNITE DEPOSIT AREA NEAR WILLISTON, NORTHWESTERN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
W. F. Horak, and O. A. Crosby.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4024, 1985. 22 p, 6 fig, 2 tab, 18 ref.

Descriptors: Aquifers, Groundwater, Surface water, *Lignite, *Strip mines, Williston, *North Dakota, Williams County.

The Avoca deposit in the Sentinel Butte member of Fort Union Formation consists of four potentially strippable lignite beds. Average bed thicknesses, in descending order, are 5, 5, 9, and 8 feet. In the area between Stony Creek and Crazy Man Coulee, the lignite beds are unsaturated, and between Stony Creek and Little Muddy River, only the two lowest beds are saturated. Aquifers in sandstone beds in the Fox Hills Sandstone and the Hell Creek Formation probably would yield as much as 50 gallons per minute of sodium bicarbonate type water. However, the aquifers are from 1,100 to 1,800 feet below land surface. Individual sand beds in the Tongue River and Sentinel Butte Members of the Fort Union Formation are the shallowest aquifers below the minable lignite beds. Properly constructed wells completed in these sand beds could yield as much as 40 gallons per minute. The water generally is a sodium bicarbonate type with dissolved-solids concentrations ranging from about 500 to 4,200 milligrams per liter. (USGS)
W86-02398

REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE NORTHERN GREAT PLAINS IN PARTS OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING--GEOCHEMICAL EVOLUTION OF GROUND-WATER COMPOSITION IN TWO CONFINED AQUIFER SYSTEMS,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02400

MATHEMATICAL MODEL OF THE TESUQUE AQUIFER SYSTEM NEAR POJOAQUE, NEW MEXICO,
Geological Survey, Lakewood, CO. Water Resources Div.
G. A. Hearne.
Available from Distribution Br., USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Water-Supply Paper 2205, 1985. 75 p, 81 fig, 17 tab, 55 ref.

Descriptors: *Mathematical models, *Groundwater movement, *New Mexico, Water levels, Withdrawal, Irrigation, Water use, Model studies, Simulation analysis.

A three-dimensional digital model of ground-water flow was constructed to represent the dipping anisotropic beds of the Tesuque aquifer system underlying the Pojoaque River basin and vicinity, New Mexico. Simulations of steady-state conditions and historical ground-water withdrawals were consistent with observed data. The model was used to simulate the response of the aquifer system to an irrigation-development plan in the Pojoaque River basin. Storage is the main source of water; 34.05 cubic feet per second (86 percent of the withdrawal rate) was simulated to be withdrawn from storage after 50 years of withdrawals for irrigation development. The maximum simulated water-level decline was 334 feet, and the net simulated streamflow capture from the Rio Grande and the Santa Cruz, Pojoaque, and Santa Fe Rivers was 5.63 cubic feet per second (14 percent of the withdrawal rate). The sensitivity of the model was tested by varying aquifer characteristics to the limits of the plausible range. Change in hydraulic head in the Pojoaque River basin is most sensitive to hydraulic conductivity. In all simulations, after 50 years of withdrawals, the maximum simulated decline in hydraulic head ranged between 210 and 474 feet, storage in the aquifer system was the source of 80 to 90 percent of the water withdrawn from wells, and streamflow capture from the Rio Grande and its tributaries plus irrigation diversions from the tributaries of the Pojoaque River simulated a decrease in the flow of the Rio Grande of between 17.13 and 21.11 cubic feet per second. (USGS)
W86-02402

WATER RESOURCES OF THE COTTONWOOD WASH WATERSHED, UTE MOUNTAIN, UTE INDIAN RESERVATION, SOUTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02404

SUMMARY OF RESULTS OF AN INVESTIGATION TO DEFINE THE GEOHYDROLOGY AND SIMULATE THE EFFECTS OF LARGE GROUNDWATER WITHDRAWALS ON THE MISSISSIPPI RIVER ALLUVIAL AQUIFER IN NORTHWESTERN MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02405

HYDROLOGY OF PRAIRIE DOG CREEK VALLEY, NORTON DAM TO STATE LINE, NORTH-CENTRAL KANSAS,
Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02406

EVALUATION OF MAJOR DIKE-IMPOUNDED GROUND-WATER RESERVOIRS, ISLAND OF OAHU, WITH A SECTION ON FLOW HYDRAULICS IN DIKE TUNNELS IN HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02407

PROGRESS REPORT ON BLACK MESA MONITORING PROGRAM-1984,
Geological Survey, Flagstaff, AZ. Water Resources Div.
G. W. Hill.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-483, 1985. 24 p, 4 fig, 9 tab, 6 ref.

Descriptors: *Groundwater, *Water level, Water quality, *Aquifers, *Arizona, Black Mesa, *Navajo Indian Reservation, *Hopi Indian Reservation, Monitoring.

The N aquifer is an important source of water in the 5,400 square-mile Black Mesa area on the Navajo and Hopi Indian Reservations. The project is designed to monitor long-term effects on the ground-water resources of the mesa as a result of withdrawals from the aquifer by a strip-mining operation. Withdrawals from the N aquifer by the mine have increased from 95 acre-ft in 1968 to more than 4,000 acre-ft in 1984. Water levels in the confined area of the aquifer have declined as much as 75 feet in some municipal and observation wells within about a 15-mile radius of the mine well field. Part of the drawdown in municipal wells is due to local pumpage. Water levels have not declined in wells tapping the unconfined area of the aquifer. Chemical analysis indicate no significant changes in the quality of water from wells that tap the N aquifer or from springs that discharge from several stratigraphic units, including the N aquifer, since pumping began at the mine. (USGS)
W86-02408

HYDROLOGY OF YUCCA MOUNTAIN AND VICINITY, NEVADA-CALIFORNIA--INVESTIGATIVE RESULTS THROUGH MID-1983,
Geological Survey, Lakewood, CO. Water Resources Div.
R. K. Waddell, J. H. Robison, and R. K. Blankennagel.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4267, 1984. 72 p, 13 fig, 10 tab, 68 ref.

Descriptors: Groundwater, Surface water, *Radioactive waste disposal, *Hydrogeology, *Groundwater movement, Path of pollutants, *Nevada, *California, Nevada test site.

Yucca Mountain, Nevada, is one of several sites under consideration for construction of the first repository for high-level nuclear waste. The climate is arid; few perennial streams are present in the region. Flash floods occasionally occur. The site is underlain by at least 1,800 meters of volcanic tuffs of Tertiary age; limestones and dolomites of Paleozoic age underlie much of the surrounding region, and, together with alluvial deposits, comprise the major aquifers. Yucca Mountain is in the Alkali Flat-Furnace Creek Ranch ground-water subbasin, which is part of the Death Valley ground-water basin. Discharge occurs at Alkali Flat almost entirely by evapotranspiration, and at Furnace Creek Ranch from small springs and seeps. Beneath Yucca Mountain, depth to water ranges from about 460 to 700 meters; the rock under consideration for construction of the repository is in the unsaturated zone. Rate of recharge at Yucca Mountain is small, perhaps much less than 5 millimeters per year. Within the saturated zone, water movement is principally along fractures. The hydraulic gradient is small east (downgradient) of Yucca Mountain, and increases to the north and west. Lack of effective-porosity data presently precludes accurate calculation of flow velocity and travel times. (USGS)
W86-02413

GEOLOGY, HYDROLOGY, AND WATER QUALITY OF THE CAMBRIAN AND ORDOVICIAN SYSTEMS IN NORTHERN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
A. P. Visocky, M. G. Sherrill, and K. Cartwright.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. Illinois State Water Survey, Illinois State Geological Survey, Cooperative Groundwater Report 10, 1985. 136 p, 45 fig, 6 tab, 123 ref.

Descriptors: *Geologic formations, *Groundwater, *Aquifers, *Confining beds, *Aquifer systems, Bedrock, Pumping, Drawdown, Water Quality, Hydrology, Geology, *Hydrogeology, Cambrian system, Ordovician system, *Illinois, Confined area, Unconfined area.

Cambrian and Ordovician strata provide much of the groundwater supply for approximately 250 municipalities and 150 industries in the northern half of Illinois. The Cambrian and Ordovician aquifers average approximately 1,000 feet in thickness, and are hydraulically interconnected and behave as a single aquifer. Recharge occurs principally by vertical percolation of precipitation in areas where the aquifers are not confined. Additional recharge in heavily pumped areas occurs through leakage across the overlying Maquoketa Confining Unit. The practical sustained yield of the Cambrian and Ordovician aquifers is estimated to be 65 million gallons per day in northeastern Illinois. Pumpage has exceeded this amount since about 1958. The largest withdrawals occur in Cook, DuPage, Kane and Will Counties. Withdrawals have caused water levels to decline as much as 900 feet in parts of these counties. In north-central and northwestern Illinois, development has not exceeded the pratical sustained yield. Groundwater in the recharge area of the Cambrian and Ordovician aquifers is chemically homogeneous and low in dissolved solids. However, significant vertical and areal changes in the chemical character of groundwater occur in the confined area. As water moves away from the recharge area to the east and south, it increases in dissolved solids. (USGS)
W86-02414

2G. Water In Soils

PREDICTING LEACHATE GENERATION IN LANDFILLS: A NEW METHOD,
Anderson (James C.) Associates, Camden, NJ.
For primary bibliographic entry see Field 5E.
W86-02122

FIELD VARIABILITY OF SOIL PHYSICAL PROPERTIES,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
A. J. Peck.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 189-221, 7 fig, 1 tab, 90 ref.

Descriptors: *Soil water, *Soil physical properties, *Variability, *Irrigation, *Solute transport, Spatial analysis, Scaling theory, Steady flow, Nonsteady flow, Sampling, Correlation analysis, Mathematical studies, Kriging, Flow, Leaching, Infiltration, Soil porosity, Drainage, Wetting.

Quantitative studies of soil variability and its impact on water and solute transport in fields are in a state of rapid development. However, several implications are apparent. A very large number of samples are needed to reasonably estimate the mean of properties with high spatial variability, such as water and solute drainage rate. Present methods for spatial analysis, which provides a means for characterizing soil variability are limited. A major problem of methods for computing the spatial scale of soil variation is the dependence of the correlogram on the length of a transect through its effect on the variance of sample data. It

is preferable to use the variogram to quantify scales of soil variation. The scaling of soil water properties provides a single parameter for describing soil variations to nonuniform soil imply that evapotranspiration and drainage are almost uniform in areas which do not lose or gain water by surface runoff. A definition of scaling factors through infiltration and drainage experiments is easier and as effective as working from soil water retention and conductivity relationships. Soil variability is a major factor contributing to nonuniform leaching of salts from fields. When the probability density function of solute transport properties has a large variance, a relatively large spatial variation in water application rates appears to have little influence on field-averaged solute concentrations during leaching. At present, an equivalent uniform medium cannot be defined to describe water and solute transport in nonuniform fields using the Richards equation. (Cassar-PTT)
W86-02129

2H. Lakes

SOURCE MOVEMENT AND EFFECTS OF NITROGEN AND PHOSPHORUS IN THE HEADWATERS OF HOP BROOK, MARLBOROUGH, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02343

2I. Water In Plants

ADVANCES IN IRRIGATION,
For primary bibliographic entry see Field 3F.
W86-02123

IRRIGATION SCHEDULING BASED ON A DYNAMIC CROP RESPONSE MODEL,
Kansas State Univ., Manhattan. Dept. of Industrial Engineering.
For primary bibliographic entry see Field 3F.
W86-02131

MODEL OF ROOT GROWTH AND WATER UPTAKE ACCOUNTING FOR PHOTOSYNTHESIS, RESPIRATION, TRANSPIRATION, AND SOIL HYDRAULICS,
Auburn Univ., AL. Dept. of Agronomy and Soils.
M. G. Huck, and D. Hillel.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 273-333, 17 fig, 2 tab, 37 ref, 3 append.

Descriptors: *Soil-water-plant relationships, *Irrigation, Model studies, *Root development, Evapotranspiration, Photosynthesis.

A model describing the growth and function of higher herbaceous plants considers several independent processes governed by a set of quantitative relationships involving the transport and transformations of water, carbon, and energy in the soil-plant-atmosphere continuum. This model, a simplification of reality, does not explicitly account for nutrient uptake, soil aeration, soil temperature, soil mechanical resistance to root penetration, or plant physiological processes (photosynthesis, respiration, stomatal closure, translocation, and allocation of assimilates). However, the model in its present state of development can predict plant responses to various sets of circumstances for comparison with observations. Possible uses for the model include root growth and distribution under different soil and climate conditions; assessment of the effects of irrigation strategies on crop response, evaporation, and drainage; and study of the role of genetic or adaptive factors involved in drought tolerance. (Cassar-PTT)
W86-02132

TECHNIQUES FOR ESTIMATING IRRIGATION WATER REQUIREMENTS,
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
R. D. Burman, R. H. Cuenca, and A. Weiss.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 335-394, 13 fig, 16 tab, 56 ref.

Descriptors: *Evapotranspiration, *Irrigation, *Soil-water-plant relationships, Computers, Penman equation, Crop coefficients, Root zone, Effective precipitation, Climatic data.

Estimation of irrigation water requirements requires determination of evapotranspiration and other factors. Methods for estimating evapotranspiration are described. These include the grass- versus alfalfa-based reference crop method; the Penman method; non-Penman methods such as Priestly-Taylor, FAO-24, Jensen-Haise, Blaney-Criddle, U.S. Soil Conservation Service TR-21, and Boorenbos-Pruitt. Methods are also given for estimating other factors: crop coefficients, rooting depth, and effective rainfall. Methods for computing evapotranspiration must be calibrated for different climates. The suitability of 16 methods are compared, using lysimeters at 10 locations worldwide. No one method works well in all climates. Commonly, the methods under- or overpredicted evapotranspiration on the order of 100% for climates unlike those in which they had been developed. Data required for four FAO methods (Blaney-Criddle, radiation, Penman, and pan evaporation) are given. Use of microprocessors and data collection instruments improve the accuracy and speed of developing irrigation water requirements. A sample problem is calculated, applying the Penman equation to estimate reference crop evapotranspiration. (Cassar-PTT)
W86-02133

2J. Erosion and Sedimentation

SEDIMENT YIELDS IN EASTERN MONTANA: SUMMARY OF DATA AND PROPOSED TECHNIQUES FOR ESTIMATING SEDIMENT YIELDS FROM SMALL, UNGAGED WATERSHEDS,
Geological Survey, Helena, MT. Water Resources Div.
J. H. Lambing.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water Resources Investigations Report 84-4200, 1984. 45 p, 3 fig, 9 tab, 35 ref.

Descriptors: *Sediment yield, *Basin characteristics, *Multiple regression, Erosion, Ungaged watersheds, Streamflow, Sediment transport, *Eastern Montana, Fort Union coal region, Power River coal region.

Sediment-yield data for 121 sites in eastern Montana have been compiled from results of studies conducted by various Federal, State, and private agencies. Methods used to determine mean annual sediment yields included reservoir sedimentation surveys, suspended-sediment sampling in streams, and estimates of gross erosion and indirect estimation based on physical characteristics of the basin. Multiple-regression equations were developed and evaluated for their adequacy in estimating mean annual sediment yields from small, ungaged watersheds in eastern Montana. Sediment yields determined from reservoir surveys were used as the dependent variable because they were considered the most representative of long-term yields. Independent variables consisted of basin characteristics which could be measured from maps or obtained from published sources. Consequently, equations developed in this study do not require onsite data. Evaluation of equations indicated that the best prediction capability was obtained when reservoir basins were segregated into classes of similar vegetation/soil complex. The predictive capability of regression equations developed for each of three classes of vegetation/soil complex, as indicated by the coefficient of determination (R2), ranged from 0.59 to 0.96. Corresponding standard errors ranged from 95 to 20 percent. The equations are applicable for small drainage basins of 2 square miles or less within the study area. (USGS)
W86-01922

ANNUAL SUSPENDED-SEDIMENT LOADS IN THE GREEN RIVER AT GREEN RIVER, UTAH, 1930-82,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. R. Thompson.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4169, 1984. 17 p, 7 fig, 1 tab, 13 ref.

Descriptors: Sedimentation, Sediment transport, *Sediment discharge, *Sediment load, Sediment, *Sedimentation rates, *Sediment yield, Sediments, *Colorado River Basin, Green River Basin, *Utah.

The Green River above gaging station 093150000 at Green River, Utah, drains about 44,850 square miles in Utah, Colorado, and Wyoming. The average annual precipitation near the station was 6.11 inches. Rocks ranging in age from Precambrian to Holocene are exposed in the Green River drainage basin above Green River, Utah. Shale, siltstone, and mudstone of Tertiary age probably are the most easily eroded rocks in the basin, and they contribute a large part of the sediment load in the Green River. During 1930-82, the U.S. Geological Survey collected records of fluvial sediment at station 093150000. Based on these records the mean annual suspended-sediment load was about 15,630,000 tons, ranging from 1,780,000 tons during 1934 to 43,400,000 tons during 1937. The minimum daily load of 54 tons was on September 27, 1956, and the maximum daily load of 2,230,000 tons was on July 11, 1936. Analysis of the suspended-sediment records collected from 1930-82 at station 093150000 indicated that the accuracy of the records is fair prior to 1945 and good for the remaining period of record. The records after 1945 reflect the use of improved sampling equipment. (USGS)
W86-01935

ESTUARY AS A SEDIMENT TRAP: ALTERNATE APPROACHES TO ESTIMATING ITS FILTERING EFFICIENCY,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W86-02076

RECENT SEDIMENTATION RATES IN CHESAPEAKE BAY,
Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2L.
W86-02077

ROLE OF FLOCCULATION IN THE FILTERING OF PARTICULATE MATTER IN ESTUARIES,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 2L.
W86-02078

ERODING SOILS: THE OFF-FARM IMPACTS,
Conservation Foundation, Washington, DC.
For primary bibliographic entry see Field 4D.
W86-02247

PROGRESS REPORT: PERFORMANCE OF THE VIBRATING U-TUBE FLUID DENSITY GAGE FOR MEASURING SUSPENDED-SEDIMENT CONCENTRATION,
Geological Survey, Minneapolis, MN. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-02348

DISTRIBUTION AND TRANSPORT OF TRACE SUBSTANCES IN THE SCHUYLKILL RIVER BASIN FROM BERNE TO PHILADELPHIA, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02410

HYDRAULIC AND SEDIMENT CHARACTERISTICS AT THE NORTH CHANNEL BRIDGE, JAMAICA BAY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
W. W. Staubitz, and S. W. Wolcott.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4085, 1985. 43 p, 6 fig, 11 tab, 23 ref.

Descriptors: Hydraulics, Tides, *Tidal currents, *Channel scour, Bottom sediments, Suspended sediments, Water quality, *New York, Jamaica Bay, North Channel Bridge, North Channel, Data collections.

Data were collected during the spring of 1984 in the vicinity of North Channel Bridge in Jamaica Bay, New York to define the hydraulic regime and the physical characteristics and chemical quality of bottom sediments. The data were used in a semi-quantitative analysis to predict the effects of bridge replacement and the attendant resuspension of bottom sediments, on the hydraulics and quality of water and bottom sediments. The bay-bottom configuration at the bridge site was defined, and continuous tidal stage and tidal velocity data were collected for about a month. In addition, eight bottom-sediment samples were collected near the bridge and analyzed. Results of the hydraulic analysis show that the proposed bridge should not have any measurable effect on the net water transport at the bridge cross section. The sediment data indicate that bottom sediments are relatively unpolluted in the vicinity of the bridge. Seventy-five percent of the resuspended bottom sediments will probably settle within 186 m of the bridge during an average ebb tide. Metals and nutrients released from the sediments to the water column are expected to be diluted far below detection limits. The extra oxygen demand exerted by the resuspended bottom sediments is also expected to be far less than ambient biochemical oxygen demand of the water column. (USGS)
W86-02412

APPROACH FOR APPRAISING THE ACCURACY OF SUSPENDED-SEDIMENT DATA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02415

2K. Chemical Processes

AVAILABILITY AND CHEMISTRY OF GROUND WATER ON THE BRUNEAU PLATEAU, SOUTH-CENTRAL IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01963

CRITICAL COMMENT ON THE INTERNATIONAL ATOMIC ENERGY AGENCY REPORT ON THE ADVISORY GROUP MEETING ON STABLE ISOTOPE REFERENCE SAMPLES FOR GEOCHEMICAL AND HYDROLOGICAL INVESTIGATIONS, VIENNA, AUSTRIA, SEPTEMBER 19-21, 1983, BY R. GONFIANTINI,
Geological Survey, Reston, VA. Water Resources Div.
T. B. Coplen, I. Friedman, and J. R. O'Neil.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4136, 1984. 6 p, 1 fig, 2 ref.

Descriptors: Geochemistry, Isotopes, Water quality standards, Oxygen isotopes.

According to U.S. Geological Survey records, a report prepared by R. Gonfiantini summarizing the findings and recommendations of the 1983 Advisory Group Meeting on Stable Isotope Reference Samples for Geochemical and Hydrologic Investigations held in Vienna does not accurately represent the consultants' consensus on three important points. The consultants (1) recommended no value for the C02-H20 oxygen isotope fractionation factor, not the cited value of 1.04115, (2) adopted a value of 1.0309 rather than 1.03086 to relate the PDB and SMOW scales, and (3) adopted a firm 180 value of -2.20% for NBS-19 on the PDB scale rather than agreeing that this would be a tentative value subject to modification when more measurements in selected laboratories are available. (USGS)
W86-01966

HYDROGEOLOGIC RECONNAISSANCE OF STRATIFIED-DRIFT AQUIFERS NEAR SIMSBURY, CONNECTICUT: AVAILABLE DATA AND FUTURE NEEDS,
Geological Survey, Hartford, CT. Water Resources Div.
J. W. Bingham.
Available from OFSS, USGS Box 24525 Lakewood, CO 80225. USGS Water-Resources Information Report 83-4145, 1984. 31 p, 4 fig, 24 ref.

Descriptors: *Glacial aquifers, *Ground-water availability, Ground-water potential, *Aquifer characteristics, Water-resources development, *Connecticut, *Town of Simsbury, Stratified-drift aquifers, Hartford County, Saturated thickness.

Hydrogeologic data from several sources were used to prepare maps showing the extent, saturated thickness, and composition of stratified-drift deposits near Simsbury, Connecticut. This synthesis of available data is intended to guide future groundwater studies by identifying favorable areas for development and additional information useful for resources planning and management. Deposits suitable for ground-water development underlie part of Stratton Brook valley and an area between the Farmington River and the community of Hoskins. Other potentially favorable areas occur east of the Farmington River near Avon, in the upper part of Stratton Brook valley and Bissel Brook valley. Extensive, thick deposits of silt, clay, and sand unsuitable for ground-water development underlie most of the Farmington River valley. In several areas of the town, subsurface data is sparse and the water-yielding characteristics of the stratified drift are unknown. (USGS)
W86-01967

RESEARCH PROGRAM FOR ATMOSPHERIC CHEMISTRY, RADIATION AND DYNAMICS,
Atmospheric and Environmental Research, Inc., Cambridge, MA.
For primary bibliographic entry see Field 5B.
W86-01996

FATES OF URANIUM AND THORIUM DECAY SERIES, NUCLIDES IN THE ESTUARINE ENVIRONMENT,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 2L.
W86-02079

WATER ANALYSIS, VOLUME 1: INORGANIC SPECIES, PART 1,
For primary bibliographic entry see Field 5A.
W86-02257

ORIGIN AND NATURE OF SELECTED INORGANIC CONSTITUENTS IN NATURAL WATERS,
University of Southern California, Los Angeles. Environmental Engineering Program.
B. A. Eichenberger, and K. Y. Chen.
IN: Water Analysis, Academic Press, Orlando, FL, 1982, Volume 1: Inorganic Species, Part 1. p 1-54, 1 tab, 255 ref.

Descriptors: *Water analysis, *Trace elements, *Trace metals, *Inorganic compounds, *Chemical reactions, Reviews, Metals, Hydrogen ion concentration, Conductance, Dissolved solids, Water quality, Drinking water, Natural waters, Metal complexes, Hydrolysis.

Inorganic species enter natural waters from a variety of sources such as the weathering of rocks and soils, atmospheric fallout, and anthropogenic inputs. The possible interactions occurring between metallic species and other solution species are described, followed by a discussion of individual metals. These interactions include: hydrolysis reactions, complexation with inorganic ligand, complexation with organic ligands, and conductance and pH effects. The pH and conductivity of the water system can control solubilization or agglomeration and therefore subsequent sedimentation of the metal species. A discussion of the possible hydrolysis products, complex species, and toxicity for 15 metals and three nonmetals in natural-water systems is given. Twelve of the metals under consideration are incorporated in the EPA Primary and Secondary Drinking Water Regulations (As, Ba, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Se, Ag, and Zn). Sb, Be, and Ni, which have also shown toxic properties, are included in the discussion. B, F, and cyanides are the three nonmetals considered. (Geiger-PTT)
W86-02258

REDOX POTENTIAL: ITS MEASUREMENT AND IMPORTANCE IN WATER SYSTEMS,
Maryland Geological Survey, Baltimore.
O. P. Bricker.
IN: Water Analysis, Academic Press, Orlando, FL, 1982, Volume 1: Inorganic Species, Part 1. p 55-83, 11 fig, 2 tab, 101 ref.

Descriptors: *Oxidation-reduction potential, *Chemical reactions, *Water anlaysis, *Trace, elements, *Natural waters, Oxidation, Trace metals, Dissolved solids, Hydrogen ion concentration, Conductance, Potentiometers, Electrodes.

Oxidation and reduction (redox) reactions play an important role in determining the behavior of many elements in the environment. The theoretical framework of redox reactions is given. The redox potential is usually measured electrometrically with an electrode pair consisting of an inert metal electrode coupled with a reference electrode. The electrometers usually employed are the direct reading meter and the null balance meter. The electrodes of the electrometer must be made of a material that is inert to chemical reaction in the system being measured, but electroactive to both the reduced and oxidized species involved. The nobel metals, boron carbide, and graphite are commonly used in electrodes. The hydrogen electrode is the ultimate reference standard of redox potential measurements. The calomel electrode and the silver-silver chloride electrode are also described. The operation of reference electrodes depends upon liquid junction effects. The redox potential is a variable of major importance in characterizing systems containing elements that exhibit more than one oxidation state. When the appropriate thermodynamic data are available, the equilibrium configuration of a redox system may be easily modeled for a given set of conditions. Perhaps the most reliable method currently available for evaluating the redox state of a system is quantitative analysis of the oxidized and reduced species of a component of the system. (Geiger-PTT)
W86-02259

ALKALINITY AND ACIDITY,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
J. R. Kramer.
IN: Water Analysis, Academic Press, Orlando, FL, 1982, Volume 1: Inorganic Species, Part 1. p 85-135, 7 fig, 5 tab, 20 ref.

Descriptors: *Alkalinity, *Acidity, *Water analysis, *Natural waters, *Chemistry properties, Trace elements, Hydrogen ion concentration, Physiochemical properties, Colloids, Chemical analysis, Chemical reactions.

Alkalinity is a routinely measured parameter for natural waters and wastewaters, whereas acidity is less commonly measured but is involved in analysis of low-pH solutions such as rainfall. Alkalinity and acidity are conservative terms that change only with the volume of the sample. Parameters that are

significant in alkalinity and acidity determinations consist of nutrients, trace metals, organic acids, gases, solids, and colloids. There is often a good relationship between specific conductance and the alkalinity for natural waters when calcium and bicarbonate ions make up the major portion of ions. The monoprotic, diprotic, and carbonate systems are considered along with Gran and modified Gran analysis of titration data, and analysis of mixed ligand systems. Some details of anlaysis of acidity and alkalinity are considered. Methods involving modified Gran analysis are encouraged although fixed-endpoint methods are briefly discussed, but particular attention is given to the use and determination of H-ion concentration rather than activity. The inability to obtain a linear function in a modified Gran analysis is often due to wrong assumptions regarding electrode response and also to the reliance on pH buffer solutions. (Geiger-PTT)
W86-02260

CONDUCTANCE: A COLLECTIVE MEASURE OF DISSOLVED IONS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 1B.
W86-02261

THEORY AND MEASUREMENT OF TURBIDITY AND RESIDUE,
Hach Co., Loveland, CO.
R. D. Vanous, P. E. Larson, and C. C. Hach.
IN: Water Analysis, Academic Press, Orlando, FL, 1982, Volume 1: Inorganic Species, Part 1. 1982, p 163-234, 37 fig, 6 tab, 15 ref.

Descriptors: *Turbidity, *Dissolved solids, *Suspended solids, *Physical properties, *Water analysis, Chemical properties, Wastewater analysis, Water quality, Natural waters, Nephelometers, Opacity, Light penetration.

Any natural water sample that the anslyst comes in contact with will invariably contain residue. The importance of monitoring residue was not fully realized and its applications were not widespread until the late 19th century. The nonspecific analytical techniques of residue analysis and turbidimetry are based largely on the physical parameter of size, with little or no significance attached to their chemical nature. The principles of light scattering that are fundamental to turbidity measurements are described, with special emphasis on Raleigh scattering and Mie scattering. The effects of sample and instrument parameters on turbidity measurement are examined. Early turbidimetric methods utilized the visual devices of Jackson, Hellige, Dubosoq, and Parr. Modern nephelometric instruments rely on detectors such as the photomultiplier tube, vacuum photodiode, the silicon photodiode, and the CdS photoconductor. Responses of commercially available nephelometers that affect the outcome of turbidity measurements are compared. Process instruments used to continually monitor turbidity are described. A comparison of various specifications of nephelometric instruments is given. The calibration and standardization of nephelometric instruments are considered along with the potential of future nephelometric developments. The procedures used for the determination of residue (suspended and dissolved solids) are reviewed. (Geiger-PTT)
W86-02262

SALINITY SOURCES AND PROBLEMS OF THE DANUBE RIVER BASIN,
North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W86-02273

SOUTHWESTERN SALINITY SITUATION: THE ROCKIES TO THE MISSISSIPPI,
Army Engineer Div. Southwestern, Dallas, TX.
For primary bibliographic entry see Field 5B.
W86-02274

SALINITY BALANCE OF THE LOWER VIRGIN RIVER BASIN, NEVADA AND ARIZONA,
Montana Univ., Missoula. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W86-02277

GRAND VALLEY SALT PICK-UP CALCULATIONS,
Bureau of Reclamation, Grand Junction, CO.
For primary bibliographic entry see Field 5B.
W86-02278

CHEMICAL REACTIONS INFLUENCING SALINITY INCREASE OF SOIL AND GROUNDWATERS IN THE GREAT BASIN, WESTERN UNITED STATES,
Nevada Univ. System, Reno. Desert Research Inst.
B. Bohm, and R. L. Jacobson.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 525-535, 4 fig, 20 ref.

Descriptors: *Groundwater, *Salinity, *Water pollution sources, Calcium, Magnesium, Sodium, Potassium, Silica, Chloride, Alkalinity.

Groundwater chemistry in the semi-arid western Great Basin is mostly controlled by common processes of rock dissolution and formation of secondary minerals. The major cations and silica are provided from dissolution of silicate minerals. Levels of Ca, Mg, SO4 and alkalinity are mostly controlled by incongruent silicate reactions. Chloride is derived from traces in rocks and only minimally from cyclic salts. It increases gradually along a flow path and due to the high solubility of its salts, its levels are not restricted. The acidity required for the advance of rock dissolution is probably mostly provided by CO2 derived from geothermal processes, and to a lesser degree from biological activity in soils and perhaps locally from the oxidation of sulfide minerals. (Author)
W86-02311

QUALITY OF GROUND WATER IN THE PRINCIPAL AQUIFERS OF NORTHEASTERN-NORTH CENTRAL WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
J. C. Ebbert.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4102, 1984. 112 p, 24 fig, 37 tab, 20 ref.

Descriptors: *Water quality, *Groundwater, Water quality standards, *Washington.

In 1979 the quality of ground water in major aquifers in northeastern-north central Washington State was assessed in terms of inorganic-chemical, trace-metal, and fecal-coliform concentrations. For the Spokane Valley aquifer some organic-chemical data were also included. Results of this assessment indicate that the ground water in the region is generally suitable for most uses. (USGS)
W86-02345

ANALYSIS OF GROUND-WATER-QUALITY DATA IN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02361

CHEMICAL AND ISOTOPIC CHARACTERISTICS OF BRINES FROM THREE OIL- AND GAS-PRODUCING FORMATIONS IN EASTERN OHIO, WITH APPLICATIONS TO THE GEOCHEMICAL TRACING OF BRINE SOURCES,
Geological Survey, Columbus, OH. Water Resources Div.
K. J. Breen, C. G. Angelo, R. W. Masters, and A. C. Sedam.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4314, 1985. 58 p, 14 fig, 11 tab, 25 ref.

Descriptors: *Brines, *Chemical properties, Oil wells, Isotope studies, *Geochemistry, Alkali metals, Alkaline earth metals, Ions, Berea Sandstone, Clinton sandstone, Albion Knox Dolomite, Rose Run sandstone, *Ohio.

Chemical and isotopic characteristics of selected inorganic constituents are reported for brines from the Berea Sandstone of Mississippian age, the Clinton sandstone, Albion Sandstone of Silurian age, and the Rose Run formation of Cambrian and Ordovician age in 24 counties in eastern Ohio. Ionic concentrations of dissolved constituents in brines from these formations generally fall in the following ranges (in millimoles per kilogram of brine): Na, Cl > 1,000; 100 < Ca, Mg < 1,000; 1 < K, Br, Sr, Li, Fe, SO4 < 100; Mn, Zn, Al, I, HCO3, SiO2 < 1. Mean ionic concentrations of Ca, Mg, Na, Cl, K, SO4 and Br, and mean values of density and dissolved solids are significantly different at the 95-percent confidence level in each formation. Only potassium has a unique concentration range in each formation. Selected concentration ratios are identified as potential indicators for geochemical tracing of brines having some history of dilution. The k:Na ratios work best for identifying the source formation of an unidentified brine. Isotopic characteristics of hydrogen and oxygen indicate a meteoric origin for the water matrix of the brines. Sulfur isotopes may have utility for differentiating brines from oxidizing ground water. (USGS)
W86-02365

GROUND-WATER QUALITY DATA FOR THE ATLANTIC COASTAL PLAIN: NEW JERSEY, DELAWARE, MARYLAND, VIRGINIA, AND NORTH CAROLINA,
Geological Survey, Trenton, NJ. Water Resources Div.
L. L. Knobel.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-154, 1985. 84 p, 1 fig, 10 tab, 8 ref, 1 pl.

Descriptors: *Coastal aquifers, Coastal plains, *Data collections, Groundwater, Statistics, *Water quality, *Groundwater data, *Atlantic Coastal Plain, Delaware, Maryland, New Jersey, North Carolina, Virginia.

This report is a compilation of chemical analyses of ground-water samples in the Atlantic Coastal Plain from North Carolina through New Jersey. It contains records of 3,616 chemical analyses of ground water selected from more than 15,000 analyses in WATSTORE. These analyses serve as the data base for interpreting the geochemistry of the northern Atlantic Coastal Plain aquifer system. Reported chemical data include common anions and cations, selected trace metals, and selected physical characteristics. (USGS)
W86-02374

VOLATILE TRACE-ELEMENT CONCENTRATIONS IN SNOWMELT CONTRIBUTIONS TO STREAMS MONITORED BY HYDROLOGIC BENCH MARK NETWORK STATIONS IN THE CONTERMINOUS UNITED STATES WHERE AVERAGE ANNUAL SNOWFALL EXCEEDS 12 INCHES,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02397

GEOHYDROLOGIC RECONNAISSANCE OF THE AVOCA LIGNITE DEPOSIT AREA NEAR WILLISTON, NORTHWESTERN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02398

REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE NORTHERN GREAT PLAINS IN PARTS

OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING--GEOCHEMICAL EVOLUTION OF GROUND-WATER COMPOSITION IN TWO CONFINED AQUIFER SYSTEMS,
Geological Survey, Lakewood, CO. Water Resources Div.
T. Henderson.
Available from Distribution Br, USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Professional Paper 1402-C, 1984. 84 p, 53 fig, 32 tab, 122 ref.

Descriptors: *Groundwater, *Geochemistry, Mass transfer, Isotope studies, *Wyoming, *Montana, Major chemical elements, Minor chemical elements, *Kootenai Formation, *Fox Hills Sandstone, *Lance Formation.

The Kootenai Formation in the Judith Basin, Montana, and the Lance Formation and Fox Hills Sandstone in the Powder River Basin, Wyoming, constitute two important sandstone aquifer systems in the Northern Great Plains region. Calculation of the saturation states of aquifer minerals suggests several carbonate, silicate, and aluminosilicate phases, which could control ground-water chemistry. Mass transfer modeling indicates that the observed behavior of major and minor dissolved species in both systems can satisfactorily be explained by equilibration with calcite and dolomite. Specific processes controlling the geochemistry of these systems are probably the incongruent dissolution of dolomite to form calcite driven by the dissolution of CO2. Plausible CO2 sources include organic carbon oxidation and lignite coalification. Aluminosilicates influence major element chemistry primarily as substrates for cation exchange. Measured variations in dissolved carbonate isotopic composition compare favorably with carbon isotopic evolution, calculated by assuming de-dolomitization. Ground-water flow rates, calculated by adjusting measured carbon-14 activities for carbonate mass transfer, are comparable to values calculated from hydrologic aquifer tests and potentiometric data. These carbon-14 flow rates average 1.6 meters per year for the Second Cat Creek aquifer of the Kootenai Formation, and 1.3 meters per year for the Lance-Fox Hills aquifer. (USGS)
W86-02400

2L. Estuaries

APPEARANCE AND WATER QUALITY OF TURBIDITY PLUMES PRODUCED BY DREDGING IN TAMPA BAY, FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 6G.
W86-01929

METHODS FOR THE COLLECTION OF GEOCHEMICAL DATA FROM THE SEDIMENTS OF THE TIDAL POTOMAC RIVER AND ESTUARY, INCLUDING DATA FOR 1978-1980 AS AN APPENDIX,
Geological Survey, Reston, VA. Water Resources Div.
S. D. Goodwin, B I. Schultz, D. L. Parkhurst, N. S. Simon, and E. Callender.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-074, 1984. 129 p, 4 fig, 4 tab, 42 ref.

Descriptors: Rivers, *Estuaries, Sediments, Pore water, Alkalinity, Sulfide, Sulfate, Phosphate, Carbon, Ammonium, Silica, Iron, Manganese, Chloride, Sodium, Potassium, Calcium, Magnesium, Porosity, Nitrogen, Phosphorus, Cores, Tidal Potomac River, *Potomac Estuary, Sediment sampling, Core processing, *Geochemical data, *Water quality, pH, Eh.

The chemical composition of bottom sediments and their associated pore waters from the tidal Potomac River and Estuary was studied from May 1978 through June 1980. Pore waters were routinely analyzed for pH, Eh, alkalinity, and concentrations of sulfide, sulfate, phosphate, carbon, ammonium, silica, iron, manganese, chloride, sodium, potassium, calcium, and magnesium. Porosity, weight loss on ignition, and carbon, nitrogen, and phosphorus contents were determined for the solid sediments. The range of salinity and chemical composition encountered in the estuary frequently necessitated modifications of standard methods of analysis. Therefore, the methods used, their modifications, and their limitations are presented in some detail. The appendix lists the data obtained from six sampling periods. (USGS)
W86-01930

ESTUARY AS A FILTER,
Proceedings of the Seventh Biennial International Estuarine Research Conference, Virginia Beach, Virginia, October 23-26, 1983. Academic Press, Orlando, FL. 1984. Edited by Victor S. Kennedy. 511 p.

Descriptors: *Estuaries, *Filtration, *Particulate matter, *Fate of pollutants, Sediments, Sedimentation, Water circulation, Management, Aquatic life.

Estuaries and coastal areas act as filters between rivers and oceans by trapping significant quantities of sediments and associated pollutants. This filter aspect is emphasized in a collection of papers concerning physical processes, geological processes, chemical-geochemical processes, biological processes, and management implications. The physical shape, mixing, circulation, characteristics, and stage of evolution of the estuary strongly influence its filtering capacity. The Chesapeake Bay and fjords such as Puget Sound are particularly effective filters for particulate matter. Chemical and geochemical processes are illustrated in case studies of nutrients and other substances in northern San Francisco Bay and in the Delaware Estuary. Biological processes involving surface foam, phytoplankton, aquatic plants, and bacteria are shown to affect nutrient and sediment transport in several estuaries. Management strategies are given for reduced freshwater inflow, sedimentation in the Mississippi Delta, pollution in the Chesapeake Bay, and the rehabilitation of water quality in the Thames Estuary. (Cassar-PTT)
W86-02070

ESTUARY AS A FILTER: AN INTRODUCTION,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. R. Schubel, and V. S. Kennedy.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 1-11, 10 ref.

Descriptors: *Estuaries, *Filtration, *Particulate matter, *Sedimentation, Suspended sediments, Sediments, Water circulation, Mixing, Rivers, Saline water, Tidal effects, Wind waves, Dissolved solids, Turbidity, Colloids, Nutrients, Organic carbon, Productivity, Aquatic life, *Fate of pollutants, Geochemistry, Management, Sediment transport.

The filter action of estuaries modifies the suspended matter and chemical regime as well as physical inputs such as currents, wind, and tides. This action has both negative effects (dissolved oxygen depletion) and positive effects (rapid recycling of nutrients and organic matter). Estuary circulation ranges from the river-dominated, highly stratified type to the thoroughly mixed, sectionally homogeneous type. The most effective filtration, where productivity is highest, occurs near the upstream limit of sea salt penetration and near the estuary mouth. The turbidity maxima are usually in the null zone, where the upstream flow of the lower layer dissipates. Geochemical removal of dissolved and colloidal material is affected by mixing, gravitational circulation, and alternate deposition and resuspension of bottom sediment by tidal scour and wind waves. Biological and biochemical filtration is a result of filter-feeding activity and biological fixation of dissolved materials into particulate form. Submerged macrophytes remove both dissolved and suspended particulates from the water. An understanding of the filtering capacities of estuaries should be incorporated into management programs. (Cassar-PTT)
W86-02071

TURBULENCE AND MIXING IN ESTUARIES,
Liverpool Univ. (England). Dept. of Oceanography.
K. F. Bowden.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 15-26, 2 fig, 19 ref.

Descriptors: *Estuaries, *Water circulation, *Mixing, *Turbulence, Currents, Water currents, Filtration, Currents, Model studies, Advection, Diffusion, Dispersion, Tidal effects, Turbidity, Rivers, Sediment transport, Saline water.

Mixing and dispersion in an estuary result from a combination of advective and diffusive processes and are closely related to patterns of circulation. The intensity and scale of turbulence depend largely on the stability of the density distribution and so affect directly the vertical fluxes of momentum and matter. Indirectly, the state of turbulence also influences the longitudinal and transverse mixing. In setting up models to predict changes in estuarine conditions arising from natural external causes or human intervention, most attention in the past has been given to longitudinal fluxes across planes perpendicular to the axis of an estuary. The apparent simplicity of one-dimensional treatments, often used for this purpose, conceals the importance of contributions from physical processes in the vertical and transverse directions. It is likely that two- and three-dimensional models will be more widely used in the future, but their successful employment calls for a better understanding of the physical processes which are to be simulated. (Author)
W86-02072

VERTICAL VARIATIONS IN RESIDUAL CURRENT RESPONSE TO METEOROLOGICAL FORCING IN THE MID-CHESAPEAKE BAY,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
D. W. Pritchard, and M. E. C. Vieira.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 27-65, 13 fig, 4 tab, 11 ref. 0CN8208363A01.

Descriptors: *Estuaries, *Filtration, *Water currents, *Wind pressure, Chesapeake Bay, Model studies, Currents, Tidal effects, Rivers, Atmospheric pressure.

Records of the nontidal current velocity obtained from current meters deployed for 20 days in two cross sections in Chesapeake Bay were used with an interpolation scheme to produce a vertical profile of the laterally-averaged longitudinal velocity component of one meter depth intervals at each section, at 3-hour intervals over the 15-day truncated record. Various statistical procedures were used to relate variations in the residual current, at each depth, to wind variations. Surface layers down to about 8 m responded directly to wind with little time lag. A slope of the water surface was also set up by the wind, with a consequent barotropic pressure force directly opposite to the wind. The current near the bottom responded first to this pressure force, flowing opposite to the wind with a phase lag of about 8 hours. This counter response proceeded up the water column, such that in the intermediate layers just below the pycnocline the negative response to the wind had a phase lag of about 20 hours. A diagnostic analytical model, based upon a Fourier transform of the linearized equations of motion, was exercised for a four-layered simulation of the vertical response of the currents to inputs of the observed fluctuations in wind and surface slope. The major features of the time variations in the residual currents in the four layers were reproduced by the model. (Author)
W86-02073

TRANSPORT VARIABILITY IN A FJORD,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
G. A. Cannon, D. E. Bretschneider, and J. R. Holbrook.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 67-78, 5 fig, 5 ref.

Descriptors: *Estuaries, *Filtration, *Fjords, *Water circulation, *Fate of pollutants, Bottom water, Mixing, Tidal effects, Dissolved solids, Suspended sediments, Particulate matter, Water circulation, *Puget Sound, *Washington, Saline water, Sediments, Rivers.

Bottom water in fjord-like Puget Sound is renewed several times a year, usually at the largest flood tides through Admiralty Inlet and at the smallest neap tides. The controlling mechanism appears to be tidal and mixing processes at the entrance sill. Although the average bottom water replacement time is about two weeks, complete renewal does not occur every two weeks. The inflowing bottom water entrains some of the seaward flowing upper water at the landward side of the sill. This acts as a filter to prevent some dissolved and particulate matter with their associated contaminants from leaving the system. (Cassar-PTT)
W86-02074

ESTUARY AS A FILTER FOR FINE-GRAINED SUSPENDED SEDIMENT,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. R. Schubel, and H. H. Carter.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 81-105, 3 fig, 2 tab, 53 ref.

Descriptors: *Estuaries, *Filtration, *Particulate matter, *Sedimentation, Suspended sediments, Sediments, Mixing, Tidal effects, Currents, Water currents, Sediment transport, Model studies, Saline water, Fate of pollutants, Stratification, Chesapeake Bay, Rivers, Turbidity, Potomac River, Wind effects.

Estuaries function as filters for the signals they receive from the land and the sea. The nontidal residual circulation, tidal mixing, and estuarine geometry determine the efficiency of this filter for suspended sediment. Tidal currents provide energy for mixing saltwater from the ocean with freshwater from the river. The resulting salinity distribution drives that part of the nontidal circulation caused by density differences, which in turn influences the salinity patterns and resulting density gradients. This feedback between salinity redistribution and gravitational circulation places a constraint (filter) on the range of variations in flow and salt concentration in the estuary. The nontidal circulation also controls the distribution and transportation of suspended sediment, and the deposition of fine particles with the estuary. The distributions of salt and fine suspended matter control the behavior of many nonconservative constituents such as nutrients, radionuclides and some metals, their modes of occurrence and transport, and their reservoirs of accumulation. The result of these processes is that the estuary modifies significantly the strength and the form of the signals it receives from land and sea. Alteration of an estuary's gravitational circulation pattern by changing its freshwater input or its geometry modifies its filtering efficiency. In general, as an estuary changes from being highly stratified toward being well-mixed, its filtering efficiency for land-derived constituents first increases to a maximum (in the partially-mixed region) and then decreases. A simple kinematic model is used to demonstrate the relationship between estuarine type and filtering efficiency for Chesapeake Bay. (Author)
W86-02075

ESTUARY AS A SEDIMENT TRAP: ALTERNATE APPROACHES TO ESTIMATING ITS FILTERING EFFICIENCY,
Delaware Univ., Newark. Coll. of Marine Studies.
R. B. Biggs, and B. A. Howell.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 107-129, 2 fig, 4 tab, 61 ref. X-003256-01.

Descriptors: *Estuaries, *Filtration, *Sedimentation, *Particulate matter, Capacity/inflow ratio, Model studies, Aquatic life, Zooplankton, Oysters, Shellfish, Suspended sediments, Sediments, Delaware Bay, Bathymetry, Sediment cores, Sediment transport, Rivers, Saline water.

The sediment trapping efficiency of estuaries for particulate matter was reviewed using several methods of estimating trapping efficiency: box models, historical changes in bathymetric data, geochronological data, and the capacity-inflow ratio (C/I). Most open water estuaries (those which have not yet evolved into deltaic systems) showed 90-100% sediment trapping efficiency. The C/I was computed for several estuaries using the mean low water volume to minimize tidal variations and the precipitation times watershed area instead of actual inflow. An exponential curve was devised to use the C/I to predict the percent sediment trapped. A >99% sediment trapping efficiency was equivalent to a C/I of about 2, about 75% t 0.05 C/I, and 30% to 0.006 C/I. A conceptual model was developed to show the source and intensity of areal depositional processes. Biologically mediated sedimentation was shown to be a major factor in sedimentation. For example, the zooplankton, oysters, and mussels in Delaware Bay fix about 400 billion kg/year of sediment. This is 200 times the annual sediment input from the rivers (1.4 billion kg/year). (Cassar-PTT)
W86-02076

RECENT SEDIMENTATION RATES IN CHESAPEAKE BAY,
Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
C. B. Officer, D. R. Lynch, G. H. Setlock, and G. R. Helz.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p.131-157, 4 fig, 2 tab, 27 ref.

Descriptors: *Estuaries, *Sediment transport, *Filtration, *Sedimentation rates, *Chesapeake Bay, Tracer studies, Susquehanna River, Rivers, Saline water.

Nonlinear parameter estimation techniques were applied to obtain optimum values and confidence intervals for mass sedimentation rates in Chesapeake Bay from Pb210, Cs137 and Pu239, 240 geochemical tracer profiles. The results show high sedimentation rates of around 0.3-1.2 g/sq cm/year for the upper bay, modest sedimentation rates of 0.1-0.3 g/sq cm/yr for the middle bay, and modest to high sedimentation rates of 0.1-0.8 g/sq cm/yr for the lower bay. The principal source for the upper bay is the Susquehanna River discharge and that for the lower bay is the ocean and lower bay environment. In terms of total sediment budget the results are in agreement with published eivdence that episodic sedimentation events are an important feature of the bay system. (Author)
W86-02077

ROLE OF FLOCCULATION IN THE FILTERING OF PARTICULATE MATTER IN ESTUARIES,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
K. Kranck.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 159-175, 6 fig, 44 ref.

Descriptors: *Estuaries, *Filtration, *Particulate matter, *Flocculation, *Sedimentation, Suspended sediments, Sediments, Rivers, Saline water, Particle size, Sediment transport, Settling velocity, Organic matter.

The structuring of suspended particulate matter in estuaries into flocculated settling entities is described and discussed. A hierarchy of three particle distribution types is described: in situ distributions contain abundant large low density fragile aggregates (macro-flocs) with high settling rates, the formation of which is promoted by low turbulence and high particulate concentrations. During periods of high currents in nature and during shipboard and laboratory sample handling, these macro-flocs break up into more stable distributions of smaller flocs which are the basic building blocks of the larger units. Laboratory oxidation of organic matter and disaggregation of aggregates allow the size analysis of individual single mineral grain distributions for purposes of direct comparison between bottom and suspended sediment spectra. The constituent grain-size distribution of the inorganic component of a floc replicates the grain size of the suspension as a whole. The diverse grain size and chemical nature of the organic matter makes its flocculation kinetics more complicated. Past laboratory experiments have indicated the existence of organic-inorganic proportions optimum for flocculation. This is substantiated by ash-loss data from three estuaries with different relative inputs of organic and inorganic matter. The particulate matter in each was dominated by similar organic-inorganic proportions (65%-75% organic matter by volume) indicating that the component in excess of this value had been preferentially exported from the estuary. Settling of suspended sediment as macro-flocs and near bottom break-up and resuspension of floc fragments control the very dynamic equilibrium between particle trapping and particle flushing in estuaries. (Author)
W86-02078

FATES OF URANIUM AND THORIUM DECAY SERIES, NUCLIDES IN THE ESTUARINE ENVIRONMENT,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. K. Cochran.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 179-220, 10 fig, 1 tab, 66 ref. OCE76-02-39.

Descriptors: *Estuaries, *Filtration, *Radioisotopes, *Tracer studies, Sedimentation, Uranium radioisotopes, Thorium radioisotopes, Radium radioisotopes, Lead radioisotopes, Polonium radioisotopes, Sediments, Suspended sediments, Mixing, Organic matter, Saline water, Bottom sediments, Sediments, Rivers, Radon, Aquatic life, Benthic fauna.

Naturally occurring radionuclides of the uranium and thorium decay series are useful in studying estuarine geochemical processes ranging from the removal of reactive nuclides from the water column to the mobilization and transport of chemical species in the sediment column. Although uranium isotopes generally show conservative behavior during estuarine mixing, removal from solution can occur at low salinities or in estuaries high in dissolved organic matter. Uranium in estuarine sediments also displays a diagenetic chemistry linked to oxidation-reduction. In contrast to uranium, radium isotopes are released during estuarine mixing. Mechanisms of release include desorption from suspended sediments and the mobilization of radium from bottom sediments. The latter is demonstrated by measurements of Ra226 and Ra228 in sediment pore waters. The thorium isotopes, Th234 and Th228, produced by decay of soluble parents U238 and Ra228, are good analogs for chemical species which interact strongly with particles in the estuary. Both have been used to estimate removal times of thorium from solution to particles. The distribution of Th234 and Th228 in sediments is governed primarily by particle mixing by the benthic fauna, and both isotopes serve as chronometers to determine mixing rates. Pb210 and its daughter Po210 also serve as tracers of reactive nuclides. Both are removed rapidly to bottom sediments. Although Pb210 is a longer lived tracer than Th234 or Th228, its depth distribution in estuarine sediments is also affected by bioturbation. Successful reconstruction of sediment chronology in the estuary thus requires the application of several tracers with different half-lives and independent information on the sediment budget of the area. (Author)
W86-02079

RESPONSE OF NORTHERN SAN FRANCISCO BAY TO RIVERINE INPUTS OF DISSOLVED INORGANIC CARBON, SILICON, NITROGEN AND PHSOPHORUS,
Geological Survey, Menlo Park, CA.
L. E. Schemel, D. D. Harmon, S. W. Hager, and D. H. Perterson.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 221-240, 6 fig, 1 tab, 29 ref.

Descriptors: *Estuaries, *Filtration, *Nutrients, Dissolved solids, Silicon, Nitrogen, Phosphorus, San Francisco Bay, Sacramento River, San Joquin

River, San Pablo Bay, Suisun Bay, Rivers, Solute transport, Seasonal variation, Water quality, Saline water, Biological filters, Phytoplankton.

Estuarine processes can be effective in modifying (filtering) distributions of dissolved inorganic forms of carbon, silicon, nitrogen, and phosphorus in northern San Francisco Bay. During winter, high inflow from the Sacramento-San Joaquin river system supplied these nutrients to the estuary at rates that exceeded potential rates of estuary supply and removal processes. During spring and summer, when inflow rates were lower, the estuary was an effective filter of the river inflow signal because rates of estuarine processes were high relative to river and other supply rates. At lower inflow rates, the river apparently influenced estuarine hydrodynamic feeatures that controlled rates of phytoplankton nutrient removal. Largest biological removal effects were localized in San Pablo Bay during spring and Suisun Bay during summer, and they were generally more pronounced in shallow water areas of the bays. In San Pablo Bay, effects of biological removal appeared soon after river inflow decreased from high winter rates, but persisted for only a short time. During the following summer months dissolved nitrogen and dissolved phosphorus distributions in San Pablo Bay indicated that estuarine sources contributed to higher concentrations of these nutrients. (Author)
W86-02080

ESTUARINE INTERACTION OF NUTRIENTS, ORGANICS, AND METALS: A CASE STUDY IN THE DELAWARE ESTUARY,
Delaware Univ., Lewes. Coll. of Marine Studies.
J. H. Sharp, J. R. Pennock, T. M. Church, J. M. Tramontano, and L. A. Cifuentes.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. P 241-258, 10 fig, 23 ref. NA80AA-D-00106.

Descriptors: *Estuaries, *Fate of pollutants, *Filtrations, *Nutrients, Phytoplankton, Metals, Heavy metals, Delaware Estuary, Geochemistry, Nutrients, Organic matter, Phosphates, Humic acids, Particulate matter, Dissolved solids, Rivers, Saline water, Iron, Phosphates, Ammonium compounds, Urea, Silicates, Nickel, Copper.

The geochemical and the biochemical processes which alter concentrations of soluble nutrients, organic matter, and trace metals were studied in the Delaware Estuary using property-salinity plots. Geochemical filtration occurred primarily in the low salinity upper estuary, where particulate concentrations were highest because of flocculation and resuspension of bottom sediments. Biochemical filtration occurred primarily in the low salinity upper property-salinity plots. Geochemical filtration occurred primarily in the low salinity upper estuary, where particulate concentrations were highest because of flocculation and resuspension of bottom sediments. Biochemical filtration occurred predominantly in the lower estuary, where biological productivity was highest. Geochemical filtration was studied with organic matter, iron, and phosphate. Dissolved organic matter and humic acid concentrations decreased with increasing salinity; amino acids generally increased with increasing salinity. Iron and phosphate concentrations decreased with increasing salinity. However, the steady-state lower limit was higher for iron (30 nM) than for phosphate (1 nM). This was attributed to the phosphorus buffer effect. Geochemical removal was most apparent during winter. Biochemical filtration was studied with nutrients and trace metals. In spring concentrations of ammonium, phosphate, silicate and urea decreased to nearly zero at a salinity of about 15. Phytoplankton activity was highest in the region of 10-22 salinity. Nickel and copper showed little filtration, despite their potential for bioreactivity. Cadmium and phsophate concentrations illustrated a combined biogeochemical filter, with geochemical exchange dominant at lower salinities and biochemical activity dominant at higher salinities. (Cassar-PTT)
W86-02081

ESTUARINE TOTAL SYSTEM METABOLISM AND ORGANIC EXCHANGE CALCULATED FROM NUTRIENT RATIOS: AN EXAMPLE FROM NARRAGANSETT BAY,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
S. W. Nixon, and M. E. Q. Pilson.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 261-290, 9 fig, 2 tab, 50 ref.

Descriptors: *Estuaries, *Filtration, *Organic matter, *Nutrients, *Narragansett Bay, *Rhode Island, Nitrogen, Phosphorus, Denitrification, Sedimentation, Mixing, Phytoplankton, Productivity, Metabolism, Saline water.

The system metabolism of Narragansett Bay, Rhode Island, was calculated from the annual nutrient input, the ratio of the annual time and volume-weighted mean concentrations of dissolved inorganic nitrogen and dissolved inorganic phosphorus, the annual rate of denitrification, and data on the chemical composition of the plankton. Results showed that the system is autotrophic, with net production exceeding consumption by about 80 g C per sq m per year. The amount or organic matter exported from the bay is 70-75 g C per sq m per year, equivalent to 22-24% of the phytoplankton production. Estimated accumulation in the sediments is about 6 g C per sq m per year; estimated removal by fisheries is about 1 g C per sq m per year. (Cassar-PTT)
W86-02082

ANTHROPOGENIC NITROGEN LOADING AND ASSIMILATION CAPACITY OF THE HUDSON RIVER ESTUARINE SYSTEM, USA,
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
T. C. Malone.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 291-311, 8 fig, 1 tab, 37 ref.

Descriptors: *Estuaries, *Fate of pollutants, *Filtration, *Nitrogen, Wastewater disposal, Hudson River Estuary, Phytoplankton, Productivity, Dissolved oxygen, Oxygen, Saline water.

The fate of sewage-derived nitrogen was studied in the Hudson River Estuary. Net export of nitrogen was negligible during March-October. During this period sewage-nitrogen accounted for 54% (March-May) to 121% (June-October) of new production. During the remainder of the year most new nitrogen was exported to adjacent coastal water with little uptake by the plume. Estimated increases in new production as a result of sewage-nitrogen loading were 77 million kg C during March-May and 94 million kg C during June-October. This was a 30% increase in phytoplankton production over the predischarge levels of 578 million kg C per year. During summer, when the phytoplankton production was highest, nitrogen was exported as plankton biomass or as fecal material. The increased phytoplankton production in response to sewage-nitrogen had little effect (about 30%) on dissolved oxygen levels because over 80% of phytoplankton production is metabolized within the plume before reaching the bottom waters. (Cassar-PTT)
W86-02083

ESTUARY EXTENDED - A RECIPIENT-SYSTEM STUDY OF ESTUARINE OUTWELLING IN GEORGIA,
Georgia Univ., Sapelo Island. Marine Inst.
C. S. Hopkinson, and F. A. Hoffman.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 313-330, 1 fig, 5 tab, 36 ref.

Descriptors: *Estuaries, *Filtration, *Marshes, *Organic carbon, Georgia, Rivers, Saline water, Organic matter, Productivity, Sedimentation, Respiration, Aquatic life, Nearshore processes, Salt marshes.

Organic carbon budgets are presented for the marsh, estuarine water bodies and the inner portion of the nearshore region of Georgia. Budgets were determined by balancing external inputs and outputs from rivers and the mid-shelf against measurements of community production, metabolism and internal organic matter storage. On the marsh, primary production exceeds sedimentation and respiration by a factor of 2.6. The aquatic system is distinctly heterotrophic, with the primary production to community respiration ratio being 0.63:1. The current best estimate is that the autotrophic marsh-estuarine system has 947 g C per sq m potentially available for export. The nearshore system requires an input of 210 g C per sq m per year in addition to primary production to sustain its high rate of community production. Allochthonous organic inputs from rivers constitute 12% of total inputs to the marsh/estuarine/nearshore interface system. Roughly 50% of carbon inputs to the interface system are unaccounted for. About 10% of net primary production of the marsh must be exported to sustain heterotrophic levels in the estuarine aquatic system and the nearshore. The nearshore region is a component of a coupled system and is strongly dependent on the adjacent marsh/estuary and river for a portion of its organic matter. As such, the nearshore can be considered as a functional extension of the estuary into the ocean. The estuary is a filter in the sense that materials received at the land-sea interface will be processed, transformed and exchanged within the marsh/estuary and the nearshore zones. (Author)
W86-02084

SURFACE FOAM CHEMISTRY AND PRODUCTIVITY IN THE DUCKABUSH RIVER ESTUARY, PUGET SOUND, WASHINGTON,
Washington Univ., Seattle. Coll. of Ocean and Fishery Sciences.
R. C. Wissmar, and C. A. Simenstad.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 331-348, 3 fig, 5 tab, 42 ref. R/F-37.

Descriptors: *Estuaries, *Filtration, *Organic matter, Foaming, Nitrogen, Chlorophyll, Adenosine triphosphate, bacteria, Sediments, Duckabush River, Hood Canal, Puget Sound, Washington, Productivity, Neritic environment, Algae, Eelgrass, Phytoplankton.

Chemical and biotic constituentsof surface foam were compared in estuarine and neritic waters of Puget Sound, Washington. The role of surface foam formation as a major filtering medium in an estuary was indicated by entrainment and concentration of constituents in foam several times higher than that of subsurface and neritic waters. Stable carbon isotopic ratios and organic solute fractions (hydrophobic and hydrophilic) indicated that organic matter in foams originated from dissolved organic carbon compounds released from seagrasses and benthic algae. Concentrations of particulate oranic carbon and nitrogen, chlorophyll a, adenosine triphosphate, and bacteria counts showed enrichment in foams due to entrained sediment particles, algae, and bacteria. Inorganic nutrient concentrations, primary production and respiration rates of estuarine foam were also severalfold greater than neritic waters. The high levels of organic and inorganic chemical constituents, and metabolic rates of the microbial community indicate that surface foams are important interfaces for cycling of nutrients, formation of detrital matter, and production of microbial forage for consumers. (Author)
W86-02085

MICROBIOLOGICAL CHANGES OCCURRING AT THE FRESHWATER-SEAWATER INTERFACE OF THE NEUSE RIVER ESTUARY, NORTH CAROLINA,
East Carolina Univ., Greenville, NC. Dept. of Biology.
R. R. Christian, D. W. Stanley, and D. A. Daniel.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 349-365, 2 fig, 3 tab, 32 ref. NA83AA-D-0012.

Descriptors: *Estuaries, *Filtration, *Bacteria, *Saline-freshwater interfaces, *Neuse River Estuary, *North Carolina, Nitrates, Phosphates, Phytoplankton, Productivity, Chlorophyll, Nitrogen.

The hypothesis that mass mortality of freshwater phytoplankton at the freshwater-saltwater interface causes rapid biogeochemical changes was

tested. Physical, chemical, and microbiological variables were studied in the Neuse River Estuary, North Carolina. Nitrate nitrogen, orthophosphate, and number of phytoplankton taxa all decreased significantly going downriver across the freshwater-seawater interface, while bacterial density and productivity rose sharply. Parameters which did not change significantly were phytoplankton density, chlorophyll a, ammonia nitrogen, and light absorption coefficient. In laboratory studies, increasing salt concentration from zero to 4 ppt produced slightly lower bacterial density and slightly higher bacterial productivity. In the same studies the following parameters were unaffected by the change from freshwater to saline water: primary productivity, chlorophyll concentration, number of phytoplankton taxa, ammonium-N uptake, and nitrate-N uptake. No evidence was found to confirm the hypotheis that salt at the interface affects the microbial community. (Cassar-PTT)
W86-02086

INFLUENCES OF SUBMERGED VASCULAR PLANTS ON ECOLOGICAL PROCESSES IN UPPER CHESAPEAKE BAY,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
W. M. Kemp, W. R. Boynton, R. R. Twilley, J. C. Stevenson, and L. G. Ward.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. P 367394, 6 fig, 2 tab, 73 ref. R80593200.

Descriptors: *Estuaries, *Filtration, *Aquatic plants, *Sediments, Submerged plants, *Organic matter, Suspended sediments, Sediments, *Chesapeake Bay, Potamogeton perfoliatus, Ruppia maritima, Phytoplankton, Turbidity, Fish, Aquatic animals, Vegetation effects, Waterfowl, Nitrogen, Phosphorus, Nutrients, Oxygen demand, Productivity, Decomposition.

Physical, chemical and biological influences of submersed vascular plants (dominated by Potamogeton perfoliatus and Ruppia maritima) on their surrounding environment are summarized for portions of Upper Chesapeake Bay. Rates of accretion of organic matter in these ecosystems were high owing to the combined effects of vascular plant and associated algal production and the trapping of particulate organics of phytoplanktonic origin. Time-series observations of seston along transects traversing vegetated bottoms indicated significantly less turbid water over the plant beds, due both to increased deposition and to decreased resuspension of fine-grain sediments. Submersed plants provided a preferred habitat for many animal populations, and abundance of fishes (predominantly juveniles) was significantly greater in these plant beds than in adjacent unvegetated areas. Recent declines in several species of migrating waterfowl which feed directly on plant material were highly correlated with contemporaneous decreases in plant distribution. Rapid uptake of dissolved inorganic nitrogen and phosphorus was demonstrated for these communities, with subsequent incorporation into plant material via both growth and facultative increases in percent N and P composition. Upon senescence and death, submersed vascular plants contributed 33% to the organic C budget, while acting as a seasonal sink for 210% and 7% of the total sediment and nitrogen inputs, respectively, to the estuary. (Author)
W86-02087

SEAGRASS FILTER: PURIFICATION OF ESTUARINE AND COASTAL WATERS,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
F. T. Short, and C. A. Short.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 395-413, 5 fig, 1 tab, 46 ref.

Descriptors: *Estuaries, *Filtration, *Sedimetation, *Aquatic plants, *Nutrient removal, Particulate matter, Seagrass, Vegetation effects, Silt, Clays, Organic matter, *Indian River, *Florida, Suspended sediments, Sediments, Nitrogen, Phosphates, Saline water.

Sediment removal and nutrient removal were studied in tanks planted with seagrass. Light penetration to specified depth of the tank increased more rapidly with time in seagrass tanks than in uplanted tanks. Halodule wrightii had a greater sediment trapping effect than Syringodium filiforme. Terrestrial organic silt was more readily settled than the other forms of ammonium chloride and sodium phosphate. The rate of phosphate removal was similar in seagrass and nonvegetated tanks (from 2 to 1 micromoles in three hours). Ammonium concentrations were reduced from 10 to 1 micromoles in seagrass tanks within 1.5 hours; from 10 to 6 micromoles in the control tank. Results were extrapolated to field conditions in Indian River Lagoon, Florida. Nitrogen removal in that seagrass community was calculated to be 3890 metric tons of N annually, 1860 tons of this during May-July. This nitrogen removal represents 11% of the nutrient load to the Indian River. However, excessive loading of nutrients or suspended material is detrimental to the seagrass community, promoting loss of the vegetated beds and their filtering mechanism. (Cassar-PTT)
W86-02088

BIOLOGICAL AND PHYSICAL FILTERING IN ARID-REGION ESTUARIES: SEASONALITY, EXTREME EVENTS, AND EFFECTS OF WATERSHED MODIFICATION,
San Diego State Univ., CA. Dept. of Biology.
J. B. Zedler, and C. P. Onuf.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 415-432, 5 fig, 2 tab, 22 ref. R/CZ-33c & R/CZ-51.

Descriptors: *Estuaries, *Filtration, *Sedimentation, Watershed, Enviromental effects, Suspended sediments, Sediments, Saline water, Semiarid lands, Tijuana Estuary, Mugu Lagoon, Colorado Lagoon, *California, Floods, Construction, Aquatic habitats, Habitats, Storms, Seasonal variation, Tidal effects, Nutrients, Channels, Marshes, Salt marshes, Invertebrates.

The filtering functions occurring in the arid region estuaries of southern California were reviewed using data from three tidally flushed systems: Tijuana Estuary, Mugu Lagoon, and Colorado Lagoon. Three hypotheses were developed. (1) The biological and physical filters differ significantly in wet and dry seasons. During the wet season plants take up nutrients, animals consume organic carbon, and sediments are deposited in channels. During the dry season no nutrients are input from the watershed. Organisms continue to filter materials from the water. The filtering function is one of nutrient uptake and recycling rather than tapping of imported particulate organic matter. (2) Extreme events such as floods substantially alter estuarine structure and fuctioning. In channels, sedimentation and salinity reduction can eliminate both plant and animal communities. In salt marshes reduced soil salinity and possibly increased nutrient levels produce increased vascular plant growth and establishment of cordgrass. (3) The combination of extreme events with hunman disturbance in the watershed has the potential for long-term consequences in the estuaries. For example, accelerated erosion from construction increases sedimentation, reducing the water depth and eliminating fish and eelgrass beds in favor of a subtidal habitat. A reservoir drawdown, prolonging the wet season, can eliminate the halophyte community. (Cassar-PTT)
W86-02089

ASSESSING AND MANAGING EFFECTS OF REDUCED FRESHWATER INFLOW TO TWO TEXAS ESTUARIES,
National Coastal Ecosystems Team, Slidell, LA.
For primary bibliographic entry see Field 6G.
W86-02090

DETERIORATION OF COASTAL ENVIRONMENTS IN THE MISSISSIPPI DELTAIC PLAIN: OPTIONS FOR MANAGEMENT,
Louisiana Universities Marine Consortium, Chauvin.
For primary bibliographic entry see Field 6G.
W86-02091

ENVIRONMENTAL CHARACTERIZATION OF CHESAPEAKE BAY AND A FRAMEWORK FOR ACTION,
Environmental Protection Agency, Annapolis, MD. Chesapeake Bay Program.
V. K. Tippie.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 467-487, 7 fig, 2 tab, 4 ref.

Descriptors: *Estuaries, *Water pollution sources, *Fate of pollutants, *Filtration, Metals, Organic compounds, Water pollution control, Water quality, Management, *Chesapeake bay, Aquatic life, Shellfish, Fish, Aquatic animals, Aquatic plants, Algae, Oysters, Submerged plants, Sediments, Nutrients, Nitrogen, Phosphorus, Dissolved oxygen, Oxygen.

Data compiled and analyzed during the EPA's Chesapeake bay Program show how the filtering action responsible for the estuary's high productivity also traps pollutants. The bay's ecology has gradually changed as follows: blue-green algal blooms have increased in frequency; submerged aquatic vegetation has declined dramatically, particularly in the upper bay and western shore tributaries; freshwater-spawning fish have declined, while marine-spawning fish have increased; and oyster spat set has decreased significantly as blue crab harvests have increased. Nutrient levels are high in the upper bay and tributaries, moderate in the eastern shore area, and normal in the lower bay. The amount of water in the main part of the bay which has low or no dissolved oxygen has increased 15-fold between 1950 and 1980. High concentrations of toxic organic compounds are in bottom sediments of the main bay near industrial facilities, near river mouths, and in areas of maximum turbidity. Metal concentrations are significantly higher than background levels in many areas; the Patapsco and Elizabeth Rivers being most highly contaminated. To reverse the decline of this ecosystem, inputs of nutrients and toxic materials must be controlled. Nutrient loadings can be reduced by implementing agricultural runoff control, urban runoff control, and point source control of industrial and wastewater treatment plant discharges. Metal loadings from point and nonpoint sources are already being reduced with the aid of the metal contamination index, the toxicity index, and effluent/sediment testing procedures. (Cassar-PTT)
W86-02092

ENVIRONMENTAL IMPACT OF POLLUTION CONTROLS ON THE THAMES ESTUARY, UNITED KINGDOM,
Thames Water Authority, Reading (England).
For primary bibliographic entry see Field 5G.
W86-02093

NUTRIENT AND DETRITUS TRANSPORT IN THE APALACHICOLA RIVER, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02356

HYDRAULIC AND SEDIMENT CHARACTERISTICS AT THE NORTH CHANNEL BRIDGE, JAMAICA BAY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-02412

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING BY REVERSE OSMOSIS AT YUMA DESALTING PLANT,

Bureau of Reclamation, Yuma, AZ. Yuma Projects Office.
K. M. Trompeter, and S. H. Suemoto.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 427-437, 5 fig.

Descriptors: *Saline water, *Salinity, *Desalination, Desalination plants, Desalination apparatus, Colorado River, Reverse osmosis, Legal aspects, Yuma, Arizona.

This paper presents the pretreatment and desalting systems at Yuma Desalting Plant at Yuma, Arizona. This discussion of processes includes sedimentation, partial lime softening, filtration, scale inhibitors, and reverse osmosis desalting. Other plant features are office, maintenance areas, computer control, energy recovery, and improving performance of treatment by use of Test Train. The key feature of the desalting plant is the reverse osmosis desalting equipment, with a capacity of 22.4 million-gallons-per day. The present status of constructin including anticipated start-up and completion dates, and an update of capital, operation, and maintenance costs, is also presented. (Halterman-PTT)
W86-02319

3B. Water Yield Improvement

SCPP DATA COLLECTION AND ANALYSIS FOR THE PERIOD 1 JANUARY 1979 THROUGH 30 SEPTEMBER 1984: VOLUME ONE - EXECUTIVE SUMMARY,
Atmospherics, Inc., Fresno, CA..
For primary bibliographic entry see Field 2B.
W86-01984

ROOFTOP RAINWATER CATCHMENT SYSTEMS FOR DRINKING WATER SUPPLY,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. J. Schiller.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 85-100, 13 fig, 9 ref.

Descriptors: *Water supply, *Drinking water, *Water conveyance, *Water storage, *Storage tanks, Potable water, Water supply development, Water tanks, Rain, Design criteria, Developing countries, Cisterns, Water demands, Computer models.

In developing countries where the fetching of water is time consuming, rooftop rainwater catchment systems (RWCS) can be a valuable asset. Rainwater catchments are a form of renewable energy technology, using solar energy, which evaporates surface water, both purifying and elevating it. Components of the RWCS are: a catchment device, a conduit system, and a storage tank. In designing such systems the components must be of adequate size and strength to provide the optimum amount of potable water at the most economical cost. A reasonable water demand will have to be selected for design considerations. The time variation of rainfall (RF) is important in designing a RWCS, because the storage tank must be designed to trap the excess rainfall for use in dry periods. Planned rationing can greatly alter the reliability of a system. The first step in designing a RWCS is to determine whether RWCS' are feasible in a given area. To correctly design a RWCS, it is necessary to take into account the variability in the particular RF pattern. Computer modeling with historical RF data is described. Another approach is to apply statistical methods to the design of RWCS systems. Several devices have been used to divert the dirt that accumulates on rooftops and is present in the first runoff of rainwater. The RWCS tank should be cleaned annually. (Geiger-PTT)
W86-02330

3C. Use Of Water Of Impaired Quality

COLORADO RIVER SALINITY - THE USER'S PERSPECTIVE,
Colorado River Board of California, Los Angeles.
For primary bibliographic entry see Field 5B.
W86-02265

IRRIGATION WITH SALINE GROUNDWATER AS A STRATEGY FOR SALINITY CONTROL IN THE SHEPPARTON REGION OF NORTHERN VICTORIA,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
R. A. Wildes.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 225-264, 2 tab, 15 ref.

Descriptors: *Salinity, *Saline water, *Water quality control, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture.

A strategy for salinity control based on private groundwater pumping and the direct, on-farm use of the water for irrigation is described. The major advantage of the on-farm approach to salinity control are that saline drainage flows to the Murray River are minimized while agricultural productivity is improved through the increased availability of irrigation water. The specific benefits include matching irrigation water salinity to suit particular crops, soils, and management methods; maximizing the productive use of groundwater, thus minimizing the amount of salt input to the Murray River; farmer-owned and operated pumps cost less than state-owned pumps; on-farm methods potentially apply to the whole area of the irrigated lands; and greater flexibility of irrigation management including the opportunity to irrigate during winter. (Halterman-PTT)
W86-02287

LIVING WITH SALINITY: AN EVALUATION OF TWO POLICY MEASURES WITHIN A REGIONAL FRAMEWORK.
Hebrew Univ. of Jerusalem (Israel). Dept. of Agricultural Economics.
D. Yaron, and A Ratner.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston, 1984. p 441-454, 1 fig, 4 tab, 15 ref.

Descriptors: *Salinity, *Saline water, Legal aspects, Jurisdiction, Water rights, Water use, Impaired water use.

Two analyses of policy measures aimed at compensating for, or reducing, salinity-induced losses in agriculture are described. The extent of income losses due to salinity depends on: the mix of crops, their sensitivity and income potential; the share of value added in gross output value; and the degree of the farm's adaptation to salinity. With regard to the latter, distinction must be made between: currently practiced crop mix and irrigation technology; crop mix adapted to salinity and currently practiced irrigation technology; and both crop mix and irrigation technology adapted to salinity. The first policy discussed is compensation for increased water salinity, which would become critical for a region when water rights are firmly practiced, and water quality deteriorates. The second policy discussed pertains to the determination of the optimal water quantity-salinity mix for a region and regional co-operation. This issue becomes important when a region can be supplied with more water, but at the cost of increased salinity. Various applications of these policies are discussed and several mathematical treatments are illustrated. (Halterman-PTT)
W86-02304

IRRIGATION AS A SOLUTION TO SALINITY PROBLEMS OF RIVER SYSTEMS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
G. R. Dutt, D. A. Pennington, and F. Turner.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 465-472, 8 tab, 8 ref.

Descriptors: *Salinity, *Saline water, *Irrigation, Irrigation engineering, Irrigation operation, Irrigation practices, Irrigation-return flow, Water use, Impaired water use.

Saline waters diverted from river systems to maintain water quality usually can be used for the production of salt tolerant crops. Irrigation by saline waters has been shown to be economically feasible in Arizona. The establishment of saline irrigation projects with their accompanying drainage systems and brine disposal facilities can economically use most waters being diverted from river systems. Field data corroborating these conclusions are provided for cotton, barley, sorghum and sugar beets. (Halterman-PTT)
W86-02305

USE OF SALINE WASTE WATER FROM ELECTRICAL POWER PLANTS FOR IRRIGATION,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
R. J. Hanks, R. F. Nielson, R. L. Cartee, and L. S. Willardson.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 473-482, 8 fig, 1 tab, 4 ref.

Descriptors: *Salinity, *Saline water, Irrigation, Irrigation engineering, Irrigation operation, Irrigation practices, Water use, Impaired water use.

Water is generally re-cycled in the evaporation-cooling system of power plants until the salinity of the water reaches a high level, at which time it is disposed of as waste water. The possible disposal of saline waste water from power plants by irrigation of crops is discussed, and is shown to be an economically sound disposal method. The long-term effects of salt and specific ions on the soil and crops are relatively unknown. Five years of experience at Huntington, Utah shows a stability in production for forage and grain crops but a continuing production decrease on root crops. Work will continue, and specific ion effects will be evaluated, to determine their importance for long-term management. (Halterman-PTT)
W86-02306

AQUATRAIN PIPELINE SYSTEM,
Bureau of Reclamation, Denver, CO. Office of Saline Water Transport and Use.
M. J. Clinton, and I. E. McKeever.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 483-492, 1 fig.

Descriptors: *Salinity, *Saline water, Colorado River, Water use, Impaired water use, Salvaged water, Conveyance structures, Pipelines, Resource development, Hydraulic engineering.

The AQUATRAIN project, a proposed pipeline system to help control Colorado River salinity, and economically transport coal to markets, is discussed. The primary goals are: to collect saline water in the Colorado River basin, transport it to points of most beneficial use, and dispose of it in the most cost effective manner; and to provide an economically competitive method of moving coal and other commodities from source points to markets, using a part of the savings in commodity transport costs to pay for the salinity control function. Sources and markets, pipeline corridor selection, program status and schedule, costs, and public involvement in the AQUATRAIN Process are discussed. (Halterman-PTT)
W86-02307

SALT GRADIENT SOLAR PONDS.
Department of Energy, Washington, DC.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 493-502, 5 fig,

1 tab.

Descriptors: *Salinity, *Saline water, *Electric power production, *Solar energy, Water use, Impaired water use, Resource development, Brine disposal.

Various aspects of the possible use of impounded brackish water for a solar power generation facility are discussed. Highly brackish water which would normally flow into the Wichita River, from a variety of sources, would instead be impounded into a solar pond. The solar pond is a device for trapping and storing solar thermal energy. The proposed salt gradient solar pond achieves this by means of a salt concentration gradient, increasing from low salinity at the surface to high salinity a meter or two below the surface. Hence deeper waters are heavier than waters above them, impeding upward movement of warmed water. Thus, the principal mechanism of heat loss in ordinary ponds is impeded. In this manner, temperatures can reach the boiling point of saline water. Coupling the pond with an organic Rankine-cycle engine will produce electricity. The feasibility is discussed in detail. (Halterman-PTT)
W86-02308

REUSING SALINE DRAINAGE WATERS FOR IRRIGATION: A STRATEGY TO REDUCE SALT LOADING OF RIVERS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
J. D. Rhoades.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston, 1984. p 455-464.

Descriptors: *Salinity, *Saline water, *Irrigation, Irrigation engineering, Irrigation operation, Irrigation practices, Irrigation-return flow, Water use, Impaired water use.

Several strategies for coping with increasing levels of salinity in river systems resulting from irrigation are discussed. Emphasis is on irrigation with saline drainage water, and cycling crop types. The process works by intercepting drainage returns before they flow back into the river, and using them for irrigation. When the water is of such poor quality (high salinity) that it is no longer usable, it is pumped into evaporation ponds. Water is conserved and salt loading is minimized by this process. The efficiency of this strategy is maximized when salt sensitive crops irrigated with river water, are rotated with salt tolerant crops which are then irrigated with reused irrigation water with higher salinity. (Halterman-PTT)
W86-02318

3F. Conservation In Agriculture

ADVANCES IN IRRIGATION,
Volume 2, Academic Press, New York, 1983. Edited by Daniel Hillel. 429 p.

Descriptors: *Water conservation, *Irrigation, *Soil-water-plant relationships, *Evapotranspiration, Model studies, Agriculture, Crop yield, Water stress.

This serial publication updates developments in irrigation science and practice. Irrigation scheduling with emphasis on timing criteria is reviewed. Energy consumption by irrigation, methods for conserving energy in irrigation and energy sources for future development are described. A review of crop-water production functions reveals the complexity of the interactions underlying the productive relationship between crops and irrigation water. In Australia irrigation is limited by political and economic factors. The plant-environment model, Cupid, is used to study the complete water budget of a crop. Soil variability has profound effects on irrigation efficiency. However, present methods have many problems, including the need for a large number of samples. Models based on the response functions of crops can be used to develop irrigation schedules. The dynamic crop response model, incorporated into a dynamic programming model, obtains the optimal irrigation schedule for given economic conditions. A model describing the growth and function of plants has several possible uses. Methods for determining evapotranspiration are reviewed. Remote sensing techniques can be applied to estimating crop stress and evapotranspiration. (Cassar-PTT)
W86-02123

IRRIGATION SCHEDULING: APPLIED TIMING CRITERIA,
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
E. C. Stegman.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 1-30, 17 fig, 1 tab, 90 ref.

Descriptors: *Water conservation, *Irrigation efficiency, Crop yield, Economic aspects, Hydrologic budget, Soil water, Evapotranspiration, Water potentials, Air temperature, Temperture.

Irrigation scheduling concepts were reviewed with emphasis on timing criteria. Yield-evapotranspiration relationships show an upper-bound region for a given set of production inputs. Upper-bound yields can be attained with a variety of irrigation schedules. Maximum economic returns are usually obtained when yields are in the maximal seasonal yield region. Water balance methods of irrigation scheduling are usable with computer technology. High efficiencies (near maximum yield with minimal annual seasonal applied depth application) can be attained with a variety of methods for estimating evapotranspiration. Allowable root zone soil water depletion criteria are the most widely used methods for irrigation timing. Some improvement has been seen in several plant-based methods: evapotranspiration deficit, leaf water potential, foliage-air temperature difference. (Cassar-PTT)
W86-02124

ENERGY UTILIZATION AND MANAGEMENT IN IRRIGATION,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
J. R. Gilley.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 31-59, 8 fig, 4 tab, 45 ref.

Descriptors: *Water conservation, *Irrigation efficiency, *Energy, *Fuels, Sprinkler irrigation, Surface irrigation, Pumps, Fertilizers.

An estimated 0.32 exajoules of energy was used to pump irrigation water in the U.S. in 1980. Natural gas accounts for 40.6%; electricity, 25.2% diesel, 21.7%; propane, 9.5%; and gasoline, 3%. Some methods of reducing energy use in irrigation include reduction in pumping volume (by improved irrigation efficiency or reduced net application); reduction in pumping head (by reduced-pressure sprinkler systems, replacement of sprinkler systems by surface systems, substitution of surface water for groundwater, reduction of friction in pipelines, or improved well design); improvement in pumping plant performance; less operation during peak electrical demand hours; improved fertilizer practices; and reduction in tillage. Energy saving practices are described for surface systems and for center-pivot sprinkler systems. Although sufficient conventional fuels are available, prices are expected to increase. Alcohol and wind power will be among the first renewable energy sources to become widely used, followed by biomass and solar systems. (Cassar-PTT)
W86-02125

CROP-WATER PRODUCTION FUNCTIONS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
H. J. Vaux, and W. O. Pruitt.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 61-97, 2 fig, 1 tab, 88 ref.

Descriptors: *Water conservation, *Irrigation efficiency, *Economic aspects, Water stress, Water use, Prices, Crop yield, Soil water, Evapotranspiration.

A review of crop-water production functions revealed the complexity of the interactions which underlie the productive relationship between crop and water in irrigated agriculture. The mechanisms which govern whether water is limiting or not is well understood, but the response of plants to the timing and level of moisture stressing in less understood. Evidence indicates that the relationship between evapotranspiration and yield is linear and that the relationship between yield and applied water is curvilinear. The factors which govern the relationship between evapotranspiration and applied water are not well understood. Thus, irrigators have little incentive to save water by permitting water to limit plant moisture stress-yield relationship is unclear. The economic literature indicates that water would be used more efficiently in agriculture if it were priced according to its true scarcity value. However, risk, timing, and interstage dependence must be considered before moisture stressing is widely practiced. (Cassar-PTT)
W86-02126

IRRIGATION IN AUSTRALIA: DEVELOPMENT AND PROSPECTS,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
R. C. Smith, W. K. Mason, W. S. Meyer, and H. D. Barrs.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 99-153, 9 fig, 11 tab, 156 ref.

Descriptors: *Water conservation, *Irrigation, *Crop yield, *Soil, Clays, Australia, Pastures, Water resources, Irrigation efficiency, Water allocation, Salinity, Saline soils, Nutrients, Root zone, Soil management, Surface irrigation.

Irrigation in Australia has been limited by political and economic factors. Most of the irrigation is used for pastures. When crops are irrigated, poor results are often obtained because of poorly permeable soil. Water is limited, highly-valuable, but low-priced. Water allocation rules make it difficult to shift the water from areas of lower productivity to areasof higher productivity. The Murray-Darling basin contains 90% of the continent's irrigated land; development here is nearly complete. The main water resource potential for irrigation expansion is in northern Australia, where crop yields are low and market opportunities scarce. Soil throughout much of the continent is unsuitable for irrigation. Heavy clays with significant levels of exchangeable sodium and magnesium lead to problems of low permeability. This soil can be managed with minimal tillage, incorporation of crop residues, better irrigation scheduling, and nutrient management. (Cassar-PTT)
W86-02127

APPLICATION OF A PLANT-ENVIRONMENT MODEL TO PROBLEMS IN IRRIGATION,
Nebraska Univ., Lincoln. Dept. of Agronomy.
J. M. Norman, and G. Campbell.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 155-188, 16 fig, 7 tab, 27 ref. NA 80AA-H-00087.

Descriptors: *Soil-water plant relationships, *Irrigation, Model studies, Evapotranspiration, Evaporation, Cupid model, Canopy, Interception, Hydrologic budget, Water loss.

The plant-environment model Cupid is useful for studying the complete water budget of a crop. Several implications were developed. About one-fourth of the evapotranspiration in Nebraska-type climate is evaporation. Interception evaporation is greatest in canopies with small leaves such as wheat or prairie grass, where it might reach 10 mm for a single event. Using air temperatures as a measure of plant temperature will introduce errors in management because air temperature differs by several degrees from those of the canopy and soil surface. For a wet soil surface and given atmospheric vapor pressure and temperature, evaporation from the soil can vary from negligible to more than 50% of the evapotranspiration. Cupid reasonably predicts the canopy water balance components; however, the interception evaporation is smaller than measurements. The model does not

consider several important factors in sufficient detail--the influence of surface residues on energy and water balances or the effects of residues, surface crusting, and surface slope in infiltration and runoff. (Cassar-PTT)
W86-02128

FIELD VARIABILITY OF SOIL PHYSICAL PROPERTIES,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2G.
W86-02129

ECONOMIC ANALYSIS OF ON-FARM IRRIGATION USING RESPONSE FUNCTIONS OF CROPS,
Hebrew Univ., Rehovoth (Israel). Faculty of Agriculture.
D. Yaron, and E. Bresler.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 223-255, 4 fig, 5 tab, 37 ref, 1 append.

Descriptors: *Water conservation, *Irrigation, *Economic aspects, *Soil-water-plant relationships, Response functions, Model studies, Linear programming, Dynamic programming, Production functions, Planning, Soil water, Crop yield.

An integrated agrobiological-economic approach to irrigation is presented. Several types of models are described, starting with the least complex: the macro response or production function in an individual crop with a fixed intraseasonal distribution of water, the dated crop response functions to irrigation and soil moisture, and dynamic programming models for irrigation scheduling. Examples of irrigation scheduling include a single crop, an entire farm, and irrigation in response to water stress. The appendix describes linear programming and gives a sample situation. (Cassar-PTT)
W86-02130

IRRIGATION SCHEDULING BASED ON A DYNAMIC CROP RESPONSE MODEL,
Kansas State Univ., Manhattan. Dept. of Industrial Engineering.
K. S. Raju, E. S. Lee, A. W. Biere, and E. T. Kanemasu.
IN: Advances in Irrigation Volume 2, Academic Press, New York. 1983. p 257-271, 4 fig, 1 tab, 6 ref. A-086-KAN. 55257-5134.

Descriptors: *Water conservation, *Irrigation, *Crop yield, *Soil-water-plant relationships, Dynamic programming, Model studies, Economic aspects, Root zone.

The dynamic crop response model was incorporated into a dynamic programming model to obtain the optimal irrigation schedule for given economic conditions. The impact of irrigation costs and grain prices in an irrigation strategy for maximum net return per hectare can be seen as economic conditions vary. The model can be used to develop experimental designs to collect data for studying the dynamics of crop growth. The method can be modified to include dynamics of soil fertility. The model accounts for several environmental factors, such as soil moisture holding capacity in the root zone. The crop response model and the evapotranspiration model can be used jointly to simulate dryland yields under various conditions and to study dry-land cropping strategies. (Cassar-PTT)
W86-02131

MODEL OF ROOT GROWTH AND WATER UPTAKE ACCOUNTING FOR PHOTOSYNTHESIS, RESPIRATION, TRANSPIRATION, AND SOIL HYDRAULICS,
Auburn Univ., AL. Dept. of Agonomy and Soils.
For primary bibliographic entry see Field 2I.
W86-02132

TECHNIQUES FOR ESTIMATING IRRIGATION WATER REQUIREMENTS,
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2I.
W86-02133

EVAPOTRANSPIRATION OBTAINED FROM REMOTE SENSING METHODS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 7B.
W86-02134

SALINITY CONTROL THROUGH WATER CONSERVATION IN THE UPPER COLORADO RIVER BASIN,
Utah State Univ., Logan. Coll. of Engineering.
A. B. Bishop, D. R. Franklin, and R. Narayanan.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 243-252, 2 fig, 1 tab, 3 ref.

Descriptors: *Saline water, *Salinity, *Water quality control, *Economic aspects, Model studies, Colorado River, Water conservation, Conservation, Water costs, Costs, Water demand, Dissolved solids.

The economic feasibility of public and private water conservation measures that could be employed in response to salinity control and increased water prices are discussed. Specific issues that are addressed include the total cost to the economy of the public sector investments in water conservation and other measures which reduce salinity; the water conservation measures in private agricultural and energy sectors which are economically efficient; and the benefits and costs of various government-sponsored water-saving techniques. Model simulations indicate that public investments in measures only for the sake of water conservation are not economically efficient since the marginal value of water is less than the cost of conservation. When factors that increase salinity levels are taken into consideration, however, the value of water conserved is greater than the cost of various conservation programs, because the water saved is used for decreasing the salinity levels downstream through greater dilution. (Halterman-PTT)
W86-02286

CASE STUDY OF A SALINITY CONTROL PROGRAM, VINTA BASIN, UTAH,
Soil Conservation Service, Salt Lake City, UT.
For primary bibliographic entry see Field 5G.
W86-02289

CASE STUDY OF A MAJOR AGRICULTURAL CONTROL PROGRAM - THE GRAND VALLEY EXPERIENCE,
Soil Conservation Service, Denver, CO.
M. E. Hess.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 285-294, 3 tab, 7 ref.

Descriptors: *Salinity, *Saline water, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture, Colorado River.

Methodologies to control salinity in the Colorado River in the vicinity of the Grand Valley include installing structural measures to reduce seepage from unlined earthen irrigation ditches; improving irrigation water management practices to reduce deep percolation from field irrigation and to enhance uniformity of irrigation applications; and implementing a monitoring and evaluation program to assess the effectiveness of salinity control measures. The structural measures (pipelines, gated pipes, ditch lining and land leveling) have reduced salt loads by an estimated 17,500 metric tons per year. Key elements of the monitoring and evaluation program include measuring surface inflow and runoff to determine water infiltration into the ground, collecting local climatological data to evaluate crop evapotranspiration requirements (to help determine deep percolation rates), and using soil moisture sensors to assess uniformity of irrigation. The use of these data for salt loading computation under improved management practices is discussed. (Halterman-PTT)
W86-02290

SALINITY CONTROL AND DRAINAGE IN NORTHERN VICTORIA (AUSTRALIA),
Victoria State Rivers and Water Supply Commission, Armadale (Australia).
K. O. Collett, and G. C. Earl.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 315-323, 1 fig.

Descriptors: *Salinity, *Saline water, *Water quality control, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agriculture, Agricultural hydrology, *Australia.

Following the irrigation-related rise of the water table and increased salinity level of the ground water, a drainage strategy was developed to prevent waterlogging and control salinity. Pumping saline groundwater and draining it into the River Murray, the initial action taken, caused reduced water quality in the River Murray. On-farm measures, such as recycling, which have been demonstrated to be a partial solution to the problem, could improve the situation. Wide scale use of on-farm alternatives have not yet been put into practice. The main points concerning the current developments in salinity mitigation are: strategies based on public scale schemes may not always be able to be justified in economic terms; integrating efforts at the on-farm level with public-scale action offers possibilities for achieving salinity control and drainage objectives within economic and other constraints; and finally, there is a willingness to modify current irrigation practices in order to achieve these objectives. (Halterman-PTT)
W86-02293

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

DRAINAGE BASINS IN ST. JOHNS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02363

EVALUATION OF COMMUNITIES FOR THE APPLICATION OF LIMITED-DETAIL STUDY METHODS FOR FLOOD-INSURANCE STUDIES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6F.
W86-02373

PHASE I SUMMARY AND PHASE II PLAN FOR COMPARING REGULATED WITH UNREGULATED STREAMFLOW IN THE YAKIMA RIVER AT UNION GAP, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
C. H. Swift.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-4015, 1985. 21 p, 5 fig, 2 tab, 8 ref.

Descriptors: River flow, *Regulated flow, *Natural flow, *River regulations, Alteration of flow, Water management (applied), Diversions, Reservoir operation, Riparian rights, Treaties, *Washington, Yakima County, Kittitas County, Yakima Indian Reservation.

A preliminary investigation of the effects of reservoir storage and canal diversion on the flow of the

Yakima River at Union Gap, Washington indicates that those effects are measurable and substantial--on the average causing a reduction of roughly one-quarter from the unregulated flow. Preliminary computations of the unregulated flow of the Yakima River at Parker (near Union Gap) for the 1978 water year using the U.S. Bureau of Reclamation's SSARR model indicate, however, that the computed flow figures contain inaccuracies. Further investigation of the model indicates that the inaccuracies can be substantially reduced by data checking and by using additional discharge records to improve the estimation of local inflows. (USGS)
W86-02378

EVALUATION OF THE CREST-STAGE GAGE PROGRAM IN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02399

DISCHARGE RATINGS FOR CONTROL GAGES AT MISSISSIPPI RIVER LOCK AND DAM 11, DUBUQUE, IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
A. J. Heinitz.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4105, 1985. 43 p, 15 fig, 7 tab, 11 ref.

Descriptors: *Discharge coefficients, *Control-gate ratings, *Iowa, Stage-discharge relations, Tainter gate, Roller gate, Current-meter measurements, Tainter-gate opening, *Mississippi River, *Lock and Dam 11.

The water level of the navigation pools on the Mississippi River are maintained by the operation of tainter and roller gates at locks and dams. Discharge ratings for the gates on Lock and Dam 11, Dubuque, Iowa, were developed from current-meter discharge measurements made in the forebays. Methodology is given to accurately compute the vertical gate openings of the tainter gates. Discharge coeffients, in equations that express discharge as a function of tailwater depth, headwater depth, and vertical height of gate opening, were determined for conditions of submerged-orifice and free-weir flow. A comparison of the rating discharges to the theoretical rating discharges is given for submerged orifice flow for the tainter and roller gates. (USGS)
W86-02401

STATISTICAL MODELS FOR ESTIMATING FLOW CHARACTERISTICS OF MICHIGAN STREAMS,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02411

4B. Groundwater Management

SALINITY CONTROL PROBLEMS ASSOCIATED WITH IRRIGATION IN SOUTH-WEST NEW SOUTH WALES, AUSTRALIA,
Water Resources Commission of New South Wales, Sydney (Australia).
For primary bibliographic entry see Field 5B.
W86-02288

SIMULATED EFFECTS OF AN ARTIFICIAL-RECHARGE EXPERIMENT NEAR PROCTOR, LOGAN COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
A. W. Burns.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4010, 1984. 17 p, 6 fig, 3 tab, 6 ref.

Descriptors: *Artificial recharge, *Surface-groundwater relationships, Logan County, *Colorado, *Simulation analysis.

An artificial-recharge experiment was conducted near Proctor, Colorado in which a computed 620 acre-feet were pumped from a well during a 4-month period. A computed 420 acre-feet were delivered at the potential reservoir site, and the remaining 200 acre-feet leaked from the pipeline. No pond was created due to the high rates of infiltration. Water levels in the nearest well (about 0.1 mile from the recharge site) rose almost 25 feet. Computer simulations indicate that this 4-month pumping-recharge experiment would cause stream depletions from the nearby South Platte River for the first 16 months, thereafter, stream accretions due to the recharge would exceed stream depletions due to pumpage. If the experiment was conducted annually, the simulations indicate that stream depletions would occur for 6 months of each year and stream acretions for the remaining 6 months once the system reached an equilibrium condition. To reach the cyclic equilibrium condition would take at least 7 years. (USGS)
W86-02344

WATER RESOURCES OF THE RATTLESNAKE BUTTE AREA, A SITE OF POTENTIAL LIGNITE MINING IN WEST-CENTRAL, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02350

GROUND-WATER HYDROLOGY OF THE SEVIER DESERT, UTAH, WITH RESULTS OF DIGITAL-COMPUTER MODELING,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02351

PRELIMINARY STUDY OF THE AQUIFERS OF THE LOWER MESILLA VALLEY IN TEXAS AND NEW MEXICO BY MODEL SIMULATION,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02353

APPRAISAL OF THE SURFICIAL AQUIFERS IN THE POMME DE TERRE AND CHIPPEWA RIVER VALLEYS, WESTERN MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02357

GROUND-WATER CONDITIONS AND WELL YIELDS IN FRACTURED ROCKS, SOUTHWESTERN NEVADA COUNTY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02364

GEOLOGY OF THE SURFICIAL AQUIFER SYSTEM, BROWARD COUNTY, FLORIDA,
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02383

DELINEATION AND DESCRIPTION OF A ZONE OF HIGHER SECONDARY PERMEABILITY IN THE SURFICIAL AQUIFER OF EASTERN PALM BEACH COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02393

MATHEMATICAL MODEL OF THE TESUQUE AQUIFER SYSTEM NEAR POJOAQUE, NEW MEXICO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02402

SUMMARY OF RESULTS OF AN INVESTIGATION TO DEFINE THE GEOHYDROLOGY AND SIMULATE THE EFFECTS OF LARGE GROUNDWATER WITHDRAWALS ON THE MISSISSIPPI RIVER ALLUVIAL AQUIFER IN NORTHWESTERN MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
D. M. Sumner, and B. E. Wasson.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4343, 1984. 17 p, 10 fig, 10 ref.

Descriptors: *Groundwater availability, *Irrigation effects, *Model studies, *Simulation analysis, *Alluvial aquifers, Groundwater recharge, Potentiometric level, *Mississippi, *Mississippi alluvial plain, Yazoo Basin, Mississippi River alluvial aquifer.

The 7,000 square-mile Mississippi River alluvial plain in north-western Mississippi (the Delta) is underlain by the prolific Mississippi River alluvial aquifer that currently (1983) yields about 1,100 Mgal/d of water to irrigation wells. Commonly, about 20 feet of clay underlying the Delta land surface is underlain by about 80 to 180 feet of sand and gravel that forms the aquifer. The Mississippi River is in good hydraulic connection with the alluvial aquifer. Generally smaller streams are less likely to have good hydraulic connection with the aquifer. Direct vertical recharge to the alluvial aquifer is small. A two-dimensional finite-difference computer model of the alluvial aquifer was constructed, calibrated, and verified using water levels observed for five dates within the period April 1981 to September 1983. The model shows that the aquifer had a net loss in storage of about 360 Mgal/d for the 2-year period April 1981 to April 1983, when pumpage was about 1,100 Mgal/d. The net inflows from the sources of recharge were: Mississippi River, 390 Mgal/d; recharge along east edge of the Delta, 170 Mgal/d; streams within the Delta, 81 Mgal/d; and areal recharge from infiltration, 180 Mgal/d. The effects of several levels of pumpage by wells were projected 20 years into the future. In 2003, the result of continued pumpage at the 1,100 Mgal/d pumping rate would be lowered ground-water levels of more than 20 feet in a large area in the central part of the Delta, and ground-water levels would continue to decline. (USGS)
W86-02405

HYDROLOGY OF PRAIRIE DOG CREEK VALLEY, NORTON DAM TO STATE LINE, NORTH-CENTRAL KANSAS,
Geological Survey, Garden City, KS. Water Resources Div.
L. E. Stullken.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4162, 1984. 49 p, 10 fig, 1 tab, 16 ref.

Descriptors: Hydrology, Steady-state model, *Groundwater flow, Recharge, Discharge, Baseflow, *Hydrogeology, Water levels, *Water yield, *Surface-groundwater relationships, *Prairie Dog Creek Valley, *Kansas.

Development of water resources has been a major factor in the economy of Prairie Dog Creek Valley in north-central Kansas. Releases from Norton Reservoir to the Almena Irrigation District averaged 6,900 acre-feet per year during 1967-76. The number of irrigation wells increased from 4 to 147 during 1947-78. Ground water in the valley is derived mostly from the alluvial aquifer. The effects of irrigation on the aquifer are indicated by water-level changes. The water in storage increased from 130,000 to 136,000 acre-feet during 1947-78 due to recharge from surface-water irriga-

tion. A steady-state model of the aquifer prior to irrigation (1947) indicated that most recharge was from precipitation (88 percent) and most discharge was to streams (54 percent) and reparian transpiration (26 percent). Although aquifer storage increased in this area, storage generally decreased in other areas of western Kansas. (USGS)
W86-02406

EVALUATION OF MAJOR DIKE-IMPOUNDED GROUND-WATER RESERVOIRS, ISLAND OF OAHU, WITH A SECTION ON FLOW HYDRAULICS IN DIKE TUNNELS IN HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
K. J. Takasaki, and J. F. Mink.
Available from Dist Branch, USGS, 604 S. Pickett St, Alexandria, VA 22304. USGS Water-Supply Paper 2217, 1985. 77 p, 40 fig, 12 tab, 51 ref.

Descriptors: *Dikes, *Groundwater barriers, *Hydraulics, *Groundwater storage, *Hawaii, Hydrogeology, *Oahu, Koolau Range, Waianae Range.

Ground-water bodies impounded by volcanic dikes constitute important reservoirs of high-quality water. These reservoirs have high hydraulic heads and are mostly isolated from saline water. The most important and productive of these reservoirs occur in the Koolau Range, where the top of the impounded water ranges to an altitude of at least 1,000 feet. The storage above sea level of these reservoirs has been roughly estimasted at 550 billion gallons. In the Waianae Range the top of the impounded water ranges to an altitude of at least 2,000 feet and the estimated storage above sea level is about 100 billion gallons. Water-development tunnels have, by breaching dike controls, reduced storage by a least 50 billion gallons in the Koolau Range and by about 5 1/2 billion gallons in the Waianae Range. A significant part of the storage thus reduced by each tunnel can be restored by bulkheading the dike or dikes which impounded the most water, as indicated by flow records gathered during tunneling. (USGS)
W86-02407

PROGRESS REPORT ON BLACK MESA MONITORING PROGRAM-1984,
Geological Survey, Flagstaff, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02408

GEOLOGY, HYDROLOGY, AND WATER QUALITY OF THE CAMBRIAN AND ORDOVICIAN SYSTEMS IN NORTHERN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02414

4C. Effects On Water Of Man's Non-Water Activities

HYDROGEOLOGY AND EFFECTS OF TAILINGS BASINS ON HYDROLOGY OF SANDS PLAIN, MARQUETTE COUNTY, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01927

EFFECTS OF URBANIZATION OF THREE PONDS IN MIDDLETON, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
L. B. House.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4051, 1984. 17 p, 9 fig, 5 tab, 7 ref.

Descriptors: *Urbanization, Storm runoff, Urban watersheds, Ponds, Watershed models, Water quality, Hydrologic budget.

A digital hydrologic model was used to simulate the effects of future residential development on pond inflow volumes and resulting water levels of three ponds in Middleton, Wisconsin. The model computed the daily water budget and the resulting water level for each pond. The results of the model calibration are presented in the report, along with the existing watershed hydrologic conditions and runoff volumes for the 1982 study period. Data was collected during 1982 to claibrate the model; the data included pond stage, ground-water levels, precipitation and other meteorological characteristics. In addition, water-quality samples were collected at each pond to characterize the water quality. Simulation of pond levels with the 1982 rainfall and fully developed watersheds did not result in stages greater than those observed in 1982. Simulation of pond levels with rainfall having a 20-year recurrence interval (1978) and hypothetical, fully developed watersheds resulted in maximum pond stages above those observed in 1982. Peak stage of Tiedeman's Pond would increase by 2.77 feet, Stricker's Pond by 3.91 feet, and Esser's Pond by 1.44 feet. Simulation of pond levels with an estimated 100-year rainfall and hyopthetical, fully developed watersheds would result in peak stage increases of 5.30, 5.32, and 1.97 feet above the peak 1982 observed stages for Tiedeman's, Stricker's, and Esser's Ponds, respectively. (USGS)
W86-01949

SIMULATED EFFECTS OF SURFACE COAL MINING AND AGRICULTURE ON DISSOLVED SOLIDS IN ROSEBUD CREEK, SOUTHEASTERN MONTANA,
For primary bibliographic entry see Field 5B.
W86-01962

PARAHO ENVIRONMENTAL DATA: BIBLIOGRAPHY,
Development Engineering, Inc., Rifle, CO.
For primary bibliographic entry see Field 10C.
W86-01983

ANALYSIS OF SALT YIELDS ASSOCIATED WITH THE CONSTRUCTION AND OPERATION OF PARIETTE DRAW WILDLIFE AREA, UTAH,
Bureau of Land Management, Denver, CO.
W. L. Jackson, and S. Hudson.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 549-558, 5 fig, 1 tab, 3 ref.

Descriptors: *Salinity, *Saline water, Water pollution, Utah, Dissolved solids, Construction.

A fifty-percent increase in annual salt yield has been recorded at the downstream (7300) gage at Pariette Draw following the beginning of construction of the Pariette Draw Wildlife Management Area. This increase occurred during a period when there was a much smaller (11%) increase in salt yield at the upstream (7200) station. However, analysis of water discharge data and station salt-loading functions (Q vs. TDS) indicate that 94% of the increase in annual salt yield at the downstream station is due to the increase in mean monthly flow, following the beginning of construction of the wildlife management area, and 6% of the increase is due to a small though statistically significant (alpha=0.05) change in the salt loading function (Q vs. TDS) at the downstream station. It is hypothesized that increased inflows from Castle Peak tributary caused downstream flows during the post-construction period to increase proportionally more than flows entering the area upstream. Because the 6-year period of record is short for this type of analysis, any results or conclusions must be considered tentative. (Author)
W86-02313

SECONDARY SALINIZATION OF WATER RESOURCES IN SOUTHERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
M. L. Sharma, and D. R. Williamson.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 571-580, 3 fig, 2 tab, 22 ref.

Descriptors: *Salinity, *Saline water, *Water pollution sources, *Land management effects, Groundwater, Evapotranspiration, Groundwater recharge, Groundwater movement, Australia.

Secondary salinization is a problem of considerable magnitude in southern Australia. The situation arises as a consequence of clearing of indigenous Eucalyptus vegetation for development of dryland agriculture. Because of reduced evapotranspiration from crops and pasture there is excess water available to mobilize the large mass of salts stored in the deep profiles. The current understanding of the various mechanisms involved is reviewed. The development of a quantitative approach to the salinization problem has provided a basis for establishing appropriate methods for prevention and reclamation. (Halterman-PTT)
W86-02315

MAGNITUDE AND FREQUENCY OF FLOOD VOLUMES FOR URBAN WATERSHEDS IN LEON COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02354

RAINFALL-RUNOFF RELATIONSHIPS AND WATER-QUALITY ASSESSMENT OF COON CREEK WATERSHED, ANOKA COUNTY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-02370

HYDROLOGY OF AREA 60, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, NEW MEXICO, COLORADO, UTAH, AND ARIZONA,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02382

EFFECTS OF STORMWATER RUNOFF ON AN URBAN LAKE, LAKE ELLYN AT GLEN ELLYN, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02392

4D. Watershed Protection

ERODING SOILS: THE OFF-FARM IMPACTS,
Conservation Foundation, Washington, DC.
E. H. Clark, J. A. Maverkamp, and W. Chapman.
1985. 252 p.

Descriptors: *Erosion control, *Sediment transport, *Soil erosion, *Soil conservation, *Nonpoint source pollution, Agricultural engineering, Farm management, Nutrients, Nitrogen, Phosphorus, Erosion rate, Water pollution effects, Precipitation, Pesticides, Bacteria, Viruses, Streams, Lakes, Reservoirs, Economic aspects, Recreation, Sedimentation, Fish, Environmental effects, Wildlife, Water quality, Eutrophication, Salinity, Water storage, Flood damage, Canals, Contours, Terracing, Land management, Sedimentation basins, Silting.

Erosion is a major problem, not only on agricultural land, but off the farm. Among erosion's impacts are waterways polluted by sediment, fertilizers, and pesticides; accelerated siltation of reservoirs and lakes; destruction of breeding grounds for fish and other aquatic life; and increased costs for dredging harbors; siltation in rivers leading to increased flooding. This comprehensive analysis of the off-farm problems reviews basic chemical, physical, hydrological, and ecological principles pertinent to the erosion problem. Detailed cost

estimates show that erosion causes $6 billion (1980 dollars) of damages each year in the U.S. Known erosion control techniques are discussed. No single technique or group of techniques is suitable and cost effective in all situations. In general, conservation tillage and contour plowing are less expensive than structural measures such as terraces and sediment basins. Nutrient transport is most easily controlled with terraces and contour plowing. Enough information exists to mitigate the most serious erosion problems. This may involve removing the most rapidly eroding land from row-crop production or completely from production. Farm management techniques are available to control off-farm erosion impacts. However, the question is whether U.S. society has the will to implement them. (Cassar-PTT)
W86-02247

QUALITY AND QUANTITY OF URBAN RUNOFF AND ATMOSPHERIC DEPOSITION IN URBAN AREAS OF SALT LAKE COUNTY, UTAH, 1980-1981,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02346

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

PHYSICAL BEHAVIOR OF PCBS IN THE GREAT LAKES.
Ann Arbor Science, Ann Arbor, MI. 1983. 442 p. Edited by Donald Mackay, Sally Peterson, Steven J. Eisenreich, and Milagros S. Simmons.

Descriptors: *Toxic wastes, *Polychlorinated biphenyls, *Aromatic compounds, *Great Lakes, Model studies, Bioconcentration potentials, Environmental sinks, Environmental persistence, Lake Michigan, Saginaw Bay, Environmental fluctuations.

PCBs are among the most notorious environmental contaminants, and the Great Lakes are invaluable as a natural resource. This book is a collection of papers presented to increase our understanding of the environmental behavior of PCBs in the Great Lakes. The topics included in this collection of papers are high resolution PCB analysis, model studeis, bioconcentration potentials, environmental sinks, environmental persistence, environmental fluctuations, physical properties, vapor exchange, and monitoring of PCBs in the Great Lakes. (Halterman-PTT)
W86-02012

HIGH RESOLUTION PCB ANALYSIS,
Texas A and M Univ., College Station. Dept. of Veterinary Physiology and Pharmacology.
S. Safe, M. Mullin, L. Safe, C. Pochini, and S. McCrindle.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 1-13, 5 fig, 4 tab, 31 ref.

Descriptors: *Pollutant identification, *Toxic wastes, *Polychlorinated biphenyls, *High resolution analysis, *Aroclors, Gas liquid chromatography, Aromatic compounds, Toxicity, Mass spectrometry, Proton magnetic resonance.

A major problem associated with the analysis and toxicology of PCBs as well as other halogenated aromatics is the multiplicity of possible isomers and congeners. Furthermore, PCB toxicity is dependent on the structure of the individual compounds. Thus, the potential environmental and health impact of PCBs must account not only for the integrated quantification of the PCB mixtures, but also the concentrations of specific congeners which are potentially toxic. This work confirms the feasibility of high resolution PCB analysis of the commercial and environmental PCB mixtures. It is anticipated that this approach will be used to accurately measure the concentrations of specific PCB isomers and to determine the effects of PCB structures on their ecological dynamics. The methodology entails high resolution glass capillary column separation coupled with EC or MS detection and requires all 209 PCB reference standards for calibration. Data, in the form of high resolution capillary gas chromatograms, were presented for Aroclor 1016 singly and combined, as well as for a PCB fraction from a fish extract. (Halterman-PTT)
W86-02013

PHYSICAL CHEMICAL PROPERTIES OF POLYCHLORINATED BIPHENYLS,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
D. Mackay, W. Y. Shiu, J. Billington, and G. L. Huang.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 59-69, 1 tab, 15 ref.

Descriptors: *Toxic wastes, *Polychlorinated biphenyls, Vapor pressures, Fugacity, *Solubilities, Henry's law constant, Octanol-water partition coefficient, Organic carbon sorption coefficient, Chemical partitioning, Biological magnification.

For predicting and interpreting the environmental behavior of PCBs, it is essential to have reliable data for their physical-chemical properties, notably those properties such as vapor pressure, aqueous solubility, Henry's law constant and the various partition coefficients such as those for octanol-water, organic carbon-water and biota water. Since it is not economically or practically feasible to derive these data for all 209 congeners, it is necessary to infer values for one compound from another. Results suggest that the addition of one chlorine reduces solubility and vapor pressure by approximately a factor of 3 (thus the Henry's law constant is little changed) and the octanol-water partition coefficient increases by a similar factor. The methodology for this study entailed reviewing the literature pertaining to the physical chemical properties of PCBs and compiling and statistically analyzing the available data. From these analyses selected values for the properties of congeners of Aroclor were inferred. (Halterman-PTT)
W86-02015

REACTIVITY AND ENVIRONMENTAL PERSISTENCE OF PCB ISOMERS,
Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab.
W. B. Neely.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 71-88, 2 fig, 7 tab, 23 ref.

Descriptors: *Toxic wastes, *Polychlorinated biphenyls, *Polychlorinated biphenyl isomers, *Environmental persistence, Solubility, Vapor pressure, Fish, Transport bioaccumulation, Air-water interface, Biodegradation, Water pollution.

Analyses of environmental samples have often resulted in the identification of a variety of the components of PCB fluid, ranging from unsubstituted biphenyl to the fully chlorinated homologue. These component compounds were examined in an effort to identify the properties that cause certain congeners to accumulate in environmental systems. Water solubility, vapor pressure, boiling point and rate constants for microbial degradation are presented for a large number of homologues of PCB. These values were applied to a model constructed to describe the distribution of the homologues in the water column and fishes of Lake Michigan. Values of vapor pressure, water solubility, octanol water solubility and molecular weight that are associated with optimum accumulation of PCB-related compounds in fish must be sufficiently low in order that the chemicals can build up in the various environmental compartments. (Halterman-PTT)
W86-02016

REVERSIBLE AND RESISTANT COMPONENT MODEL OF HEXACHLOROBIPHENYL ADSORPTION-DESORPTION RESUSPENSION AND DILUTION,
Manhattan Coll., Bronx, NY. Dept. of Environmental Engineering and Science.
D. M. Di Toro, and L. M. Horzempa.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 89-113, 9 fig, 1 tab, 24 ref. R805229.

Descriptors: *Toxic wastes, *Hexachlorobiphenyl, *Polychlorinated biphenyls, Adsorption, Desorption, Model studies, Suspension, Suspended sediments, Dilution, Suspended particles.

The complete understanding of the fate of toxic chemicals in natural waters depends, in part, on the ability to determine the rates of adsorption to and desorption from suspended particles. To this end, experimental data on these variables were gathered and entered into a theoretical framework for a model of adsorption and desorption of hexachlorobiphenyl. In addition, data were gathered on the effects of varying suspended sediment concentrations under conditions that might be encountered in field situations. (Halterman-PTT)
W86-02017

PCBS IN THE LAKE SUPERIOR ATMOSPHERE 1978-1980,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
S. J. Eisenreich, B. B. Looney, and G. J. Hollod.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 115-125, 1 fig, 2 tab, 34 ref. CR806084.

Descriptors: *Toxic wastes, *Path of pollutants, *Polychlorinated biphenyls, *Lake Superior, *Great Lakes, Lake Michigan, Air Pollution, Air-water partition coefficients, Aerosolization, Air-water interface, Volatility.

Atmospheric concentrations of PCBs were measured over Lake Superior during the summers of 1978 and 1980, the years before and after the 1979 legislated ban on their production and use. These tests were conducted to determine if the ban resulted in a decrease in the atmospheric burden of these compounds. There is no substantive indication that atmospheric levels of PCBs are decreasing. Shipboard atmospheric samplers were used to measure air-borne concentrations above Lake Superior. Samples of atmosphere above Minneapolis were taken, as well, for comparison purposes. PCB levels over Lake Superior ranged from 0.9 to 3.5 ng per cu m in 1978 and ranged from 0.1 to 2.5 ng per cu m in 1980. Although the mean PCB concentration decreased by 33%, no statistically valid decrease can be assigned. The values observed at Lake Superior are similar to those observed for southern Lake Michigan. (Halterman-PTT)
W86-02018

PCB ACCUMULATION IN SOUTHERN LAKE MICHIGAN SEDIMENTS: EVALUATION FROM CORE ANALYSIS,
Wisconsin Univ.-Madison. Water Chemistry Lab.
D. E. Armstrong, and D. L. Swackhamer.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 229-244, 3 fig, 2 tab, 20 ref. CR-807836-01-1.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Lake Michigan, Sediment, Gas chromatography, Water pollution, Volatility, Transport, Radioactive dating.

The analysis of sediment core samples from lakes can serve as an indicator of loading of PCBs to a lake system. The work described here indicates that PCB deposition has occured in Lake Michigan since 1928 plus or minus 9 years, and that total PCB accumulation in southern Lake Michigan sediments is about 3400 to 5000 kg. Box corers obtained 9 x 24 x 25.5 cm lake sediment samples. Samples were analyzed for PCBs and dated using Pb-210 dating methodologies. Data on PCB concentrations in core depth profiles are presented for four sampling stations located in south-central Lake Michigan. (Halterman-PTT)
W86-02024

ESTIMATING BIOCONCENTRATION POTENTIAL FROM OCTANOL/WATER PARTITION COEFFICIENTS,
Environmental Research Lab.-Duluth, MN.
G. D. Veith, and P. Kosian.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 269-282, 3 fig, 2 tab, 2 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Bioconcentration potentials, *Partition coefficients, Model studies, Bioaccumulation, Clorinated hydrocarbons, Fathead minnow, Bluegill, Rainbow trout, Mosquito fish, Coho salmon, Guppy, Flagfish, Spot, Sheepshead minnow, Carp, Channel catfish, Topmouth Gudgeon.

A previously derived structure-activity relationship (SAR), which is used to estimate the bioconcentration potential of fish from the n-octanol/water partition coefficient (P), was calculated from data on approximately 50 tests on five general classes of chemicals. That SAR is summarized as: log BCF equals 0.85 log P - 0.70. To assure optimal accuracy in work involving estimating the bioconcentration of potentials, it is useful to determine if the most appropriate SAR is used. This study presents a new SAR, based on over twice as many tests as that previously described. Although the two are slightly different, they predict identical bioconcentration factors (BCF). The authors reviewed 122 tests in order to derive the new SAR, which is summarized as follows: log BCF equals 0.79 log P - 0.40. (Halterman-PTT)
W86-02026

MODEL SIMULATION OF PCB DYNAMICS IN LAKE MICHIGAN,
De Paul Univ., Chicago, IL.
P. W. Rodgers.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 311-327, 4 fig, 4 tab, 16 ref. 807412.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Great Lakes, *Lake Michigan, Water pollution, *Model studies, Suspended solids, Adsorption, Sediments, Sediment-water interface, Partition coefficients, Mass balance.

In the 1970s, the findings of high concentrations of PCBs in fish flesh in Lake Michigan led to the need to accurately determine their dynamics in that water body. The development of a model of PCB loadings and the processes which influence their distribtion are detailed. The model was derived using four primary mass balance equations on solids in the water column and sediment layer, and PCB in the water column and sediment layer. Resuspension rates, sedimentation rates, and partitioning coefficients were also major variables of the program. Research is continuing on the use of the model for historical trends in PCB loading. Currently, the model is appropriate for answering questions of system response to various loading scenarios, losses and coefficient values. (Halterman-PTT)
W86-02028

MONITORING OF PCBS IN WATER, SEDIMENTS AND BIOTA OF THE GREAT LAKES - SOME RECENT EXAMPLES,
Ontario Ministry of the Environment, Toronto.
P. B. Kauss, K. Suns, and A. F. Johnson.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 385-409, 11 fig, 4 tab, 11 ref.

Descriptors: *Toxic wastes, *Polychlorinated biphenyls, *Great Lakes, *Monitoring, Sediments, Niagara River, Freshwater clams, Sportfishes, Forage fishes, Spottail shiners, Smallmouth bass, Yellow perches, White sucker, Coho salmon, American eel.

Continued monitoring is an important aspect of our understanding and predictive capabilities regarding PCBs in the Great Lakes region. To this end, the Ontario Ministry of the Environment monitors PCBs in the waters, sediments and biota of the Great Lakes. Examples of the monitoring programs and some of the results are presented. Lake and river water, sediments, industrial and municipal inputs, suspended sediments, freshwater clams, sportfish and forage fish were sampled and analyzed. PCB concentrations in bottom sediments of the Niagara River sampled in 1979 ranged from non-detectable to 2700 micrograms per kilogram. Raw water sampled downstream of known sources had the highest PCB concentrations. PCB levels in migratory fish were not useful for pinpointing PCB sources. Young-of-the-year spottail shiners collected near specific sites thought to be sources, exhibited high PCB concentrations. Also, clams collected near certain sources had elevated levels of PCBs. (Halterman-PTT)
W86-02030

SIMULATED PRECIPITATION REFERENCE MATERIALS, IV,
National Bureau of Standards (NML), Gaithersburg, MD.
W. F. Koch, G. Marinenko, and J. W. Stolz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-139378, Price codes: A02 in paper copy, A01 in microfiche. Report NBSIR 82-2581, June 1982. 17p, 12 tab, 10 ref. AD-13-F-2-535-0.

Descriptors: *Pollutant identification, *Water analysis, *Acid rain, Precipitation, Hydrogen ion concentration, Acidity, Precipitation, Standards, Chemical analysis, Trace elements, Conductance.

A fourth series of simulated precipitation reference material was characterized. Stability of samples from the first three series of simulated precipitation was evaluated. These samples, stored in glass ampoules, were not stable with respect to pH, conductance, acidity, alkali metals, and several of the transition elements. It was recommended that future sample series be divided--one set simulating the major components (mineral acids, alkali salts, and alkaline earth salts) and the other, stabilized with nitric acid, simulating the trace elements. All samples should be stored in clean polyethylene bottles. Variations in pH measurements using different electrodes indicated that this protocol needs revision. An interim pH measurement method is described. Determination of acidity by titrating to a fixed pH endpoint was not accurate enough for acid rain analysis. Preferred techniques are titration to an inflection point (or multiple inflection points for mixed acid systems) or the Gran method. (Cassar-PTT)
W86-02040

BROAD-SPECTRUM ANALYSIS OF THE REMOVAL OF TRACE ORGANICS IN AN OZONE-GRANULAR ACTIVATED CARBON POTABLE-WATER PILOT PLANT STUDY,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5B.
W86-02165

ANALYSIS OF ORGANIC COMPOUNDS ADSORBED ON GRANULAR ACTIVATED CARBON FILTERS USED IN TREATMENT PLANTS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. S. Millington, D. J. Bertino, T. Kamei, and R. F. Christman.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 445-454, 4 fig, 1 tab, 8 ref. CR808551.

Descriptors: *Pollutant identification, *Water treatment, *Activated carbon, *Organic compounds, Gas chromatography, Mass spectrometry, Extraction, Sample preparation, Filters, Solvents, Chromatography.

Solvent extraction with Soxhlet apparatus, solvent extraction with ultrasonic agitation, and thermal desorption were compared in desorbing organic matter in carbon samples from water treatment plants. Preliminary results indicated that thermal desorption was least time-consuming and gave a clearer picture of the early eluting components. However, some problems concerning the apparent loss of the high-boiling compounds and the possibility of thermal changes in composition warrant further study. Of the two extraction methods, ultransonic agitation seemed simpler, faster, and less error-prone. About 60 compounds or groups of compounds were identified. Many of these identifications have not been confirmed by comparison with authentic compounds. (Cassar-PTT)
W86-02166

NEW APPROACHES TO THE PRODUCTION OF 36 CL-LABELED CHLORINATING AGENTS AND THE MEASUREMENT OF 36CL INCORPORATED INTO BIOLOGICAL MATERIALS,
Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
H. A. Ghanbari, W. B. Wheeler, and J. R. Kirk.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 543-553, 4 fig, 1 tab, 14 ref. PFR 78-27067.

Descriptors: *Fate of pollutants, *Chlorine, *Radioactive tracers, Tracers, Chlorine dioxide, Hypochlorous acid.

Cl36-labeled hydrochloric acid was used to produce two labeled radioactive tracers for use in studying the fate of chlorine: (1) Cl36-labeled hypochlorous acid by potassium permanganate oxidation at a yield of 80% and (2) Cl36-labeled chlorine dioxide by an electrolytic process at 43% yield. A biological material pyrohydrolyzer was developed to prepare samples for chlorine analysis while retaining 99% of the introduced radioactivity. (Cassar-PTT)
W86-02172

ANALYSIS OF ORGANIC N-CHLORAMINES,
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
F. E. Scully, J. P. Yang, M. A. Bempong, and F. B. Daniel.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 555-561, 2 fig, 1 tab, 7 ref. CR807254-01.

Descriptors: *Pollutant identification, *Chloramines, *Water analysis, 5-Dimethylamino-1-naphthalenesulfinic acid, Chromatography.

Identification of N-chloramines in chlorinated water systems has been performed using a newly synthesized aromatic sulfinic acid (5-dimethylamino-1-naphthalenesulfinic acid monohydrate). This compound reacts with the chloramines to produce highly fluorescent dansyl derivatives. To detect chloramines at molar concentrations of 10 to the minus 6 power to 10 to the minus 4 power, the reagents are added to a test tube in the following order: 42 mg of sodium bicarbonate, 1 ml of chloramine solution, 1 ml acetonitrile, 100 microliters of 0.1 M solution of the sulfinic acid compound in 0.5M sodium bicarbonate, and 2 drops of 1M sodium hydroxide. The reagents are mixed, and the tube is sealed and placed in the dark for 3 hours. After extraction with chloroform, the product is concentrated for analysis by high performance liquid chromatography. Derivatives of chlorine and the following compounds have been studied: ammonia, aniline, sec-butylamine, ethylenediamine, piperidine, L-leucine. For N-chloropiperidine, the lower limit of detectability is about 10 ng. The fluorescence of the sulfinic acid derivatives is directly proportional to the original concentration of the underivatized N-chloramine. (Cassar-PTT)
W86-02173

NEW METHODS FOR GAS CHROMATOGRAPHIC ANALYSIS OF WATER POLLUTANTS,
Radian Corp., Austin, TX.

L. H. Keith, R. C. Hall, R. C. Hanisch, J. E. Henderson, and R. G. Landolt.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 563-582, 16 fig, 2 tab, 5 ref. 68-03-2965.

Descriptors: *Pollutant identification, *Chromatography, Gas chromatography, Chlorinated hydrocarbons, Organic compounds, Pesticides, Trihalomethanes, Acetonitriles, Polychlorinated biphenyls, Haloacetonitriles.

Two enhancements of gas chromatographic analysis for aquatic pollutants are described: the thermally modulated electron-capture detector (TMECD) and two-dimensional gas chromatography. The TMECD consists of two electron-capture detectors separated by a temperature-controlled pyrolysis unit. It relies on the differences before and after pyrolysis to produce a peak area ratio. Pyrolysis can affect signals in three ways--enhancement, diminishing, or no change--depending on the compound. With the two-dimensional system (post-detector-peak recycling) a sample is chromatographed on one column; the peaks of interest are trapped and thermally desorbed onto a second column, which differs from the first column. The compound can be identified using two retention times. These methods are applied to mixtures of haloacetonitriles and trihalomethanes in drinking water. The TMECD system is also applicable to mixtures of chlorinated hydrocarbon pesticides, polychlorinated biphenyls, and phthalate esters. (Cassar-PTT)
W86-02174

NEW DEVELOPMENTS IN DYNAMIC HEADSPACE ANALYSIS OF HALOGENATED ORGANICS,

A. R. Trussell, J. G. Moncur, F-Y. Lieu, R. R. Clark, and L. Y. Leong.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 583-592, 5 fig, 1 tab, 11 ref.

Descriptors: *Pollutant identification, *Chromatography, *Water analysis, *Organic compounds, Chlorinated hydrocarbons, Pesticides, Insecticides, Aromatic compounds, Capillary columns, Purge and trap procedures.

Use of capillary columns in the purge and trap technique for analysis of halogenated organics in environmental samples has improved quality assurance with capillary resolution. In addition the following advantages were shown: (1) Minimum detection limits for halogenated organics are in the low nanogram-per-liter range. (2) The purge-desorb-analyze procedure allows processing of two samples per hour. (3) The range of recovered compounds has been extended to include organics with boiling points as high as 300 degrees C, for example, dichlorobenzenes, trichlorobenzenes, hexachloroethane, hexachlorocyclopentadiene, hexachlorobutadiene, chlorinated naphthalenes, and chlorinated biphenyls. (4) The fused silica capillary column used in the volatile analysis is coated with liquid-phase SE-54, which also resolves other extractable chlorinated organics and pesticides. This allows simultaneous analysis of volatile and extractable chlorinated organics. (Cassar-PTT)
W86-02175

GAS CHROMATOGRAPHIC ANALYSIS OF PURGEABLE HALOCARBON AND AROMATIC COMPOUNDS IN DRINKING WATER USING TWO DETECTORS IN SERIES,

SRI International, Menlo Park, CA.
B. A. Kingsley, C. Gin, D. M. Coulson, and R. F. Thomas.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 593-608, 6 fig, 2 tab, 7 ref. 68-03-3031.

Descriptors: *Pollutant identification, *Water analysis, *Chromatography, *Organic compounds, Chlorinated hydrocarbons, Trihalomethanes, *Gas chromatography, Aromatic compounds.

Water samples were monitored for both halocarbons and aromatic compounds in a single analysis, using serially connected photoionization detection and electrolytic conductivity detection. This allowed resolution of many identification problems caused by coeluting compounds. The following advantages were demonstrated. (1) Greater sensitivity is obtained than can be obtained by effluent splitting. (2) More information is provided by the simultaneous analysis than by use of either analysis separately. Misidentification of benzene in samples containing trichloroethylene is eliminated. (3) The ability to confirm halocarbon contaminants in trihalomethane-containing water is greatly increased. (4) Analysis time and instrument costs are reduced because one gas chromography performs the work of two. (Cassar-PTT)
W86-02176

REVIEW OF ANALYTICAL METHODS FOR REACTIVE OXIDANT SPECIES IN CHLORINATED WATERS,

Oak Ridge National Lab., TN.
R. L. Jolley, and J. H. Carpenter.
IN: Water Chlorination: Environmental Impact and Health Effects: Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 611-652, 9 tab, 76 ref.

Descriptors: *Pollutant identification, *Literature reviews, *Water analysis, *Chlorine, Oxidation, Chemical analysis, Potentiometers, Amperometry, Colorimetry, Spectrophotometry, Chemiluminescence, Titrimetry, Seawater, Chloramines, Wastewater analysis.

The literature concerning analytical methods for active chlorine-containing species in water has been reviewed. A table summarizes the principal techniques currently in use, their applicability, and the lower limits of detection. These methods are potentiometry, spectrophotometry, colorimetry (8 specific methods listed), chemiluminescence, and titrimetry (4 specific methods listed). With currently available data, selection of a method most suitable for a particular water sample is difficult. EPA-recommended methods for chlorine in water are iodometric titration, DPD (N,N-diethyl-p-phenylenediamine)-colorimetric, or DPD-titrimetric. Specific methods are discussed for the following types of samples: natural and treated waters, polluted waters (which often have unsatisfied chlorine demand), and seawater. Criteria are given for making judgments on reported concentrations of chlorine or oxidants: water quality, analyst expertise, methodology, and statistical significance. Problems of detecting oxidants in the trace and parts-per-billion range are discussed. (Cassar-PTT)
W86-02177

CHLORINE ANALYSIS: PERSPECTIVES FOR COMPLIANCE MONITORING,

Public Service Electric and Gas Co., Newark, NJ.
R. Sugam.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 653-666, 1 fig, 5 tab, 11 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, Oxidation, Residual chlorine, Monitoring, Amperometry, Titration, Seawater, Brackish water, Chlorine flux monitor.

Several methods for total residual chlorine analysis were evaluated in the field at fresh water, brackish water, and seawater sites. Methods included manual amperometric titration, automatic amperometric titration, amperometric back-titration, and chlorine flux monitor. Two amperometric (forward) titration methods (manual and automatic) were recommended as the best methods for low-level chlorine analysis. Under optimum conditions they can be used accurately and precisely to levels as low as 0.030 (manual) and 0.016 (automatic) mg/liter chlorine. Relative precision (95% confidence level) over a range of at least 1.0 mg/liter was +20%, -17% for the manual method and +30%, -23% for the automatic method. Cost of instrumentation for the manual method is considerably less, but endpoint detection is easier with automatic titration. Analytical precision was poorest at the seawater site, reflecting the more rapid decay of brominated oxidants compared with chlorinated analogs. The chlorine flux monitor recovered less oxidant than the other methods at the brackish water and seawater sites. It was not suitable at levels below 0.016 mg/liter. Back-titration recovered slightly less oxidant than forward titration. Amperometric back-titration was not suitable for levels less than 0.061 mg/liter; it was too complex for routine use. (Cassar-PTT)
W86-02178

EXPERIENCE WITH AMPEROMETRIC TITRATIONS FOR TOTAL CHLORINE IN THE MICROGRAMS-PER-LITER RANGE: LIMITATIONS TO ACCURACY,

Maryland Univ., College Park. Dept. of Chemistry.
G. R. Helz, D. A. Jaworske, and L. Kosak-Channing.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 667-680, 5 fig, 1 tab, 19 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, *Amperometry, Iodine, Bromine, Oxidation, Trace levels, Accuracy, Residual chlorine, Errors, Iodates, Chemical analysis.

Chemical factors which limit accuracy of amperometric titration of chlorine-produced oxidants in natural water are related to iodine chemistry. Factors affecting accuracy (systematic errors) include additive errors (interferences from natural oxidizing agents such as oxygen or iodate ion, colloidal manganese tetrahydroxide, and reagent impurities) and multiplicative errors (volatilization of iodine or other oxidant species during determination). In seawater the disproportionation of iodine to form iodate can cause systematic underdetermination of chlorine-produced oxidants by a factor of 3 or more. The apparent rapid oxidation loss during analysis of free bromine is not caused primarily by volatilization, but by formation of iodate. Some precautions for minimizing the effect of systematic error on a result include (1) avoiding the mixing order, (sample + buffer) + iodide, (2) using the standard additions method with a minimum of two additions, and (3) monitoring unchlorinated intake water for interferences. (Cassar-PTT)
W86-02179

SENSITIVE, SIMPLE DETERMINATION OF OXIDANTS IN CHLORINATED WATERS,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. H. Carpenter, R. G. Zika, and C. A. Moore.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 681-697, 9 fig, 14 ref.

Descriptors: *Pollutant identification, *Water analysis, *Rhodamine B, *Fluorescence, *Chlorine, Oxidation, Bromine, Trihalomethanes, Organic compounds, Hypobromous acid.

The use of rhodamine B, a fluorescent compound, was explored in a method for determining chlorine-produced oxidant in water. The reaction of hypobromous acid with rhodamine B was studied by adding increments of hypobromus acid to the dye at pH 4 and a seawater bromide ion concentration. The predominant species was molecular bromine. Fluorescence decreased in direct proportion to the amount of added hypobromous acid. However, at concentrations lower than 0.004 ppm chlorine equivalent the reaction of rhodamine B with hypobromous acid appeared to change character. Different ranges of chlorine equivalent were handled by using four aliquots of sample and adding different amounts of rhodamine B, corresponding to 0.02, 0.10, 0.50, and 2.00 mg/liter chlorine equivalent. Different responses of rhodamine B were noted at pH 4 and pH 8. Four analytical classes were considered for differentiation: free

chlorine, free bromine, combined chlorine, and combined bromine. Fluorescence decreases at pH 8 were greatest with HOBr, followed by HOCl, NHBr2, and NH2Cl. (Cassar-PTT)
W86-02180

MEASUREMENT OF RESIDUAL CHLORINE COMPOUNDS IN WASTEWATER WITH AMPEROMETRIC MEMBRANE ELECTRODES,
Xertex Corp., Hauppauge, NY.
J. W. Stanley, and R. Nossel.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 699-715, 11 fig, 2 tab, 13 ref.

Descriptors: *Pollutant identification, *Wastewater analysis, *Chlorine, *Chloramines, Residual chlorine, Amperometry, Electrodes, Membranes.

The 82125 total residual chlorine analyzer measures molecular iodine liberated by oxidation of iodide by reproducing existing accepted methodology, but with limited selectivity for active ammonia chloramines. An added feature is minimal electrode fouling for low-maintenance operation. The membrane electrode and accompanying reagent addition system is suitable for quantitative and continuous measurement of total residual chlorine in domestic and light industrial wastewaters. The 82125 CAC (chloramine) analyzer incorporates iodide in a supporting internal electrolyte and measures triiodide ion liberated by membrane-permeable halogen species. This current response is proportional to the active ammonia chloramine fraction of the measured residual and is independent of pH (5-8.5) and temperature (5-25 degrees C). Observed current sensitivities indicate that the minimum detection limits for the membrane electrode designs are about 0.022 mg/liter as chlorine and 0.092 mg/liter as chlorine for the total residual chlorine and chloramine designs respectively. (Author)
W86-02181

SIMULTANEOUS KINETIC ANALYSIS OF CHLORINE AND CHLORAMINE IN AQUEOUS SOLUTION AT MICROMOLAR CONCENTRATION LEVELS,
Hartford Univ., West Hartford, CT. Dept. of Chemistry.
E. T. Gray, and H. J. Workman.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 723-731, 3 fig, 6 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, Simultaneous kinetic analysis, N,N-diethyl-p-phenylenediamine, Chloramines, Iodides.

A simultaneous kinetic method of analysis for free and combined chlorine-containing compounds is feasible when using N,N-diethyl-p-phenylenediamine (DPD) with an iodide catalyst. The sensitivity of 1-2 micromoles is limited by the cell path length and the molar absorptivity of the oxidized DPD. Further investigations are aimed toward lowering the detection limit of this technique to the nanomolar levels by varying the primary reducing agent. (Author)
W86-02182

IMPROVED DETERMINATION OF TOTAL RESIDUAL CHLORINE AT LOW (MICROGRAM-PER-LITER) CONCENTRATIONS IN NATURAL WATERS,
New York State Office of Public Health, Albany. Center for Labs. and Research.
E. Canelli, and S. O. Quinn.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 733-741, 1 fig, 4 tab, 9 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, N,N-Diethyl-p-phenylenediamine, Colorimetry, Residual chlorine, Trace levels.

The N,N-diethyl-p-phenylenediamine (DPD) method combined with preliminary ethyl acetate extraction produces a simple, rapid colorimetric field method for determining total residual chlorine at a detection limit of less than 5 micrograms/liter chlorine. The method involves reduction of free or combined chlorine with an excess of potassium iodide at pH 4.7. The triiodide ion prepared is extracted with ethyl acetate and reacted with aqueous DPD reagents. The reaction product is then extracted into the water phase and measured spectrophotometrically at 515 nm. The ethyl acetate removes interferences from turbidity-causing substances such as insoluble carbonates, silicates, metal oxides, manganese dioxide, and plankton. (Cassar-PTT)
W86-02183

FLOW-STREAM DETERMINATION OF CHLORINE SPECIES WITH AN OXYGEN AMPEROMETRIC DETECTOR,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. T. Coburn, J. B. Kafil, K. G. Schick, and C. O. Huber.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 743-750, 5 fig, 5 ref. 1435.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, *Chloramines, Amperometry, Hydrogen peroxide, Iodides, Electrodes, Trace levels.

A technique for rapid, direct, and sensitive determination of specific chlorine species below parts-per-million levels depends on the catalytic effect of iodide to separate chlorine species reacting in the following order: HOCl>NH2Cl>NHCl2. Iodide and hydrogen peroxide are added as individual streams to the sample. The detector consists of a Teflon membrane-covered circular, planar platinum electrode with an internal silver-silver chloride reference electrode. Limits of detection as mg/liter chlorine are as follows: HOCl, 0.008; NH2Cl, 0.08; and NHCl2, 0.2. Since monochlorinated amino acids react similarly to monochloramine, these compounds cannot be separately identified. (Cassar-PTT)
W86-02184

HYPOCHLORITE AND MONOCHLORAMINE DETERMINATIONS USING THE SILVER IODIDE VOLTAMMETRIC ELECTRODE,
Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
T. N. Morrison, A. N. Tsausis, and C. O. Huber.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 751-759, 4 fig, 1 tab, 3 ref. 1435.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, Trace levels, Chloramines, Voltammetry, Hypochlorite, Monochloramine.

Silver iodide as a voltammetric electrode material provides for useful new chlorine species analytical methods. Configuration of the electrodes and nature of the applied potentials can be selected to optimize the measurements. Major advantages of the silver iodide electrode methods are: no reagents are required, data are rapidly accumulated, it is amenable to flow injection techniques, low (parts-per-billion) limits of detection are possible, the circuitry is relatively simple, and electrodes are easily prepared and maintained. A disadvantage of the silver iodide electrode is that no response has been observed for dichloramine at pH 7-8. This deficiency is somewhat offset by the instability of dichloramine at this pH. (Author)
W86-02185

POTENTIOMETRIC TOTAL RESIDUAL CHLORINE ANALYSIS IN A CONTINUOUS-FLOW SYSTEM,
G. Scarano, M. G. Saroglia, and V. Festa.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 761-772, 8 fig, 2 tab, 9 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, Electrodes, Oxidation, Seawater, Residual chlorine, Orion 97-70 electrode, Monitoring, Potentiometry.

The Orion 97-70 electrode is a rapid, simple means for continuous determination of low-level total residual oxidant in fresh water and seawater. The electrode responds rapidly enough for use in automated flow analysis. The sensor consists of a platinum redox electrode that develops a potential based on relative levels of iodine and iodide ions in solution and an iodide-ion selective electrode that develops a potential based exclusively on the iodide level in solution. The difference in these two potentials is related to the iodine concentration present in solution that is equal to the total residual oxidant concentration after reaction with the iodide reagent in a pH 4 acetate buffer solution. The accuracy and precision compare with those of the amperometric titration method. Since this sensor is not specific for chlorine, bromine oxidants are also included in the determination. The method is usable over a total residual oxidant range of 0.005 to 1 mg/liter. (Cassar-PTT)
W86-02186

MONITORING TOTAL RESIDUAL CHLORINE BY POTENTIOMETRIC ANALYSIS,
ORION Research, Inc., Cambridge, MA.
J. Soderberg, and J. Synnott.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 773-788, 7 fig, 2 tab, 12 ref.

Descriptors: *Pollutant identification, *Water analysis, *Wastewater analysis, *Chlorine, Oxidation, Potentiometers, Monitoring, Amperometry, Seawater, Cooling water.

Total residual chlorine was measured in five types of water samples by potentiometric and amperometric methods. The samples included cooling water, treated industrial waste from organic industries, treated industrial waste from inorganic industries, treated industrial waste from aluminum industries, and combined domestic/industrial/storm water treated waste. Excellent correlation between the two methods was obtained for all samples at the low part-per-billion level. The potentiometric method compared with the N,N-diethyl-p-phenylenediamine method in a drinking water sample also gave excellent correlation. A commercially available chlorine monitor performed satisfactorily in the field in three situations: river cooling water, treated municipal wastewater, and saline cooling water. (Cassar-PTT)
W86-02187

ENVIRONMENTAL 'TERMITE' INSPECTIONS,
W. A. Duvel.
IN: Hazardous Waste Management for the 80's, Ann Arbor Sciences, Ann Arbor, MI, 1982. p 143-162, 1 fig, 1 tab, 2 exhibits.

Descriptors: *On-site investigations, *Environment, *Pollutants, Economic aspects, Field tests, Groundwater, Water quality, Financial feasibility.

The Environmental Termite Inspection is a new term being applied to site evaluations conducted in relation to commercial and industrial real estate transactions. The inspection usually entails a source characterization, evaluation of hydrogeologic conditions, development of a site map, a detailed site reconnaissance, some subsurface exploration, some evaluation of the population potentially exposed, and a summary risk assessment. The importance of considering water features of the land is stressed, and techniques for non-invasive and invasive subsurface exploration are described. These techniques can include ground surface radar (for determining groundwater depth), resistivity testing, radioactivity detection, organic vapor detection, and analyses of water, soil, waste, and sludge samples. The inspection looks at what hazardous materials are present on the parcel of land; what pathways might serve as conduits for off-site migration; what population is exposed to these

materials; and what adverse conditions could result from this exposure. The cost of such investigations is considered, and the level of investigation required is discussed in relation to the proposed use of the land. (Halterman-PTT)
W86-02223

CHLORINATED DIOXINS AND DIBENZOFURANS IN THE TOTAL ENVIRONMENT,
Butterworth Publishers, Boston. 1983. Edited by G. Choudhary, L. H. Keith, and C. Rappe. 416 p.

*Chlorinated hydrocarbons, *Hydrocarbons, *Chlorinated dioxins, *Chlorinated dibenzofurans, Chemical analysis, Gas chromatography, Chromatography, Mass spectrometry, Public health, Ecosystems, Ecology.

The growing concern for the health hazards of exposure to chlorinated dioxins and dibenzofurans in the total environment led to a symposium held in conjunction with the national meetings of the American Chemical Society. The topics covered include chemical characterization, environmental transport, residues in Great Lakes, breakdown products, levels in wastewater, levels in environmental samples, analytical procedures, and occupational exposures and effects. (Halterman-PTT)
W86-02233

2,3,7,8-TETRACHLORODIBENZO-P-DOXIN AND 2,3,7,8-TETRACHLORODIBENZOFURAN RESIDUES IN GREAT LAKES COMMERCIAL AND SPORT FISH,
Health and Welfare Canada, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W86-02234

DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN INDUSTRIAL AND MUNICIPAL WASTEWATERS, METHOD 613: DEVELOPMENT AND DETECTION LIMITS,
California Analytical Labs., Inc., Sacramento.
A. S. Wong, M. W. Orbanosky, P. A. Taylor, C. R. McMillan, and R. W. Noble.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston, 1983. p 165-192, 9 fig, 1 tab, 4 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, Chlorinated dioxins, Chemical analysis, Gas chromatography, Chromatography, Public health, Regulations.

As a result of public comment and recent advances in analytical procedures, the standard method of determination of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-tetra-CDD) recognized by the EPA has been developed. The final version of the procedure is typical of the methodologies developed for other priority pollutants requiring solvent extractables, except that the labelled internal standard is added to every sample. The aqueous sample is extracted with methylene chloride, which is then exchanged to hexane, which is then washed with 10 N NaOH and concentrated sulfuric acid, to remove acidic and basic co-extracts and any neutral compounds that react easily with concentrated sulfuric acid. The assay step is performed using a capillary column that gives a unique isomer-specific separation for 2,3,7,8-tetra-CDD and is coupled to an MS detector operating in the SIM mode. Criteria for qualitative confirmation are that the GC column be isomer-specific; all 2,3,7,8-tetra-CDD (native and internal standard) coelute; the chlorine isotope ratio is within 10% of the calibration standard; and all peaks are greater than 2.5 times the noise level. (Halterman-PTT)
W86-02235

OCCURRENCE OF TETRACHLORODIBENZO-P-DIOXIN IN ENVIRONMENTAL SAMPLES FROM SOUTHWEST MISSOURI,
Environmental Protection Agency, Kansas City, MO. Region VII.
R. D. Kleopfer, W. W. Bunn, K. T. Yue, and D. J. Harris.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston. 1983. p 193-201, 1 fig, 2 tab, 9 ref.

Descriptors: *Chlorinated hydrocarbons, *Water pollution, *Missouri, *Hydrocarbons, *Chlorinated dioxins, Chemical analysis, Gas chromatography, Public health, Ecosystems, Ecology, Fish.

Following the discovery of illegally disposed tetrachlorodibenzo-p-dioxin (tetra-CDD) in southwest Missouri, a series of investigations has been conducted to determine the extent of contamination in the area. Water, fish, soil, sediments and air samples were analyzed. The highest levels ranged from 33,000 to 343,000 ppb, found in storage tanks and a contaminated horse arena. The highest levels in fish were found in suckers, ranging from 5 to 55 ng/kg. The highest levels found in fish were from specimens collected from the area where the highest sediment levels were observed. Although cleanup efforts are underway, investigations and monitoring of the problems are expected to continue for several years to come. (Halterman-PTT)
W86-02236

COMPOSITION OF POLYCHLORINATED DIBENZOFURAN AND DIBENZO-P-DIOXIN RESIDUES IN SEDIMENTS OF THE HUDSON AND HOUSATONIC RIVERS,
Columbia National Fisheries Research Lab., MO.
J. D. Petty, L. M. Smith, P-A. Bergqvist, J. L. Johnson, and D. L. Stalling.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston, 1983. p 203-207, 3 tab, 12 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Chlorinated dioxins, *Chlorinated dibenzofurans, Chemical analysis, Gas chromatography, Chromatography, Mass spectrometry, Public health, Ecosystems, Ecology, Fish, Sediments.

The methodologies and results of analysis of sediment and fish samples, from the Hudson and Housatonic Rivers, for polychlorinated dibenzofuran and dibenzo-p-dioxin (PCDF and PCDD, respectively) are outlined. The variable results obtained indicate the need for additional work in this area. The samples contained both compounds, primarily the higher-chlorinated congeners. The hepta- and octa-congeners predominated in sediments and tetra- and penta-congeners predominated in fish. Insufficient evidence exists to determine the differences between the profiles in fish and sediments. (Halterman-PTT)
W86-02237

NEW GAS CHROMATOGRAPHIC DETECTOR FOR TETRACHLORODIBENZO-P-DIOXIN AND TETRACHLORODIBENZOBURAN ANALYSES,
Radian Corp., Austin, TX.
L. H. Keith, L. D. Ogle, A. E. Jones, R. C. Hanisch, and R. C. Hall.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston. 1983. p 239-257, 12 fig, 8 tab, 4 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Chlorinated dioxins, *Chlorinated dibenzofurans, Chemical analysis, Gas chromatography, Chromatography, Mass spectrometry, Public health, Ecosystems, Ecology.

Gas chromatography and a new prototype detector, a thermally modulated electron-capture detector (TMECD) appear to offer a unique new method for screening for tetrachlorodibenzo-p-dioxin and tetrachlorodibenzofuran at trace levels in complex samples. A great benefit of this method is its high sensitivity to most pollutants of interest. The lower limit of detection for these samples was about 1 ppb. The technique can be used to analyze tissues, fly ash, soil, water and transformer oils. It has the potential to save large sums of money because samples can be screened, and negative samples can be eliminated from costly mass spectrometry analyses. (Halterman-PTT)
W86-02238

VALIDATION STUDY FOR THE GAS CHROMATOGRAPHY/ATMOSPHERIC PRESSURE IONIZATION/MASS SPECTROMETRY METHOD FOR ISOMER-SPECIFIC DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,
National Center for Toxicological Research, Jefferson, AR.
R. K. Mitchum, W. A. Korfmacher, and G. F. Moler.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston. 1983. p 273-286, 7 fig, 6 tab, 18 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Chlorinated dioxins, *Chlorinated dibenzofurans, Chemical analysis, Gas chromatography, Chromatography, Mass spectrometry, Public health, Ecosystems, Ecology.

Following the increased need for an isomer-specific method for 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-tetra-CDD) determinations, new laboratory and analytical techniques have been developed. The apparatus, reagents, sample clean-up procedures, homogenization, digestion, extraction, silica HPLC, reverse-phase HPLC, sample quantification, recovery experiments, and a series of validation experiments are described. The validation experiments have been successful in identifying and quantifying these compounds. (Halterman-PTT)
W86-02239

CHLORINATED DIOXINS AND DIBENZOFURANS IN THE TOTAL ENVIRONMENT II.
Butterworth Publishers, Boston. 1985. Edited by Lawrence H. Keith, Christopher Rappe, and Gangadhar Choudhary. 547 p.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Aquatic environment, *Water analysis, *Chemical analysis, *Fish, *Aquatic insects, *Biological magnification, Ecosystems, Polychlorinated dibenzo-p-dioxin, 2,3,7,8-tetrachlorodibenzo-p-dioxin, Polychlorinated dibenzofuran.

Current research on various aspects of the contamination of the total environment (air, water, soil) with chlorinated dioxins and dibenzofurans is presented. Discussion topics include synthesis, isolation, characterization and destruction of these compounds; the fate and distribution of polychlorinated dioxins (PCDD) and polychlorinated di dibenzofurans (PCDF) in the aquatic environment (including analysis of sediment samples, bioavailability to aquatic insects and residues found in fish); the analysis and effects of human exposure to PCDD and PCDF; soil sampling and analysis; and emission from incineration sources. (Halterman-PTT)
W86-02240

HISTORICAL RECORD OF POLYCHLORINATED DIOXINS AND FURANS IN LAKE HURON SEDIMENTS,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
J. M. Czuczwa, and R. A. Hites.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Butterworth Publishers, Boston, 1985. p 59-63, 2 fig, 11 ref. 80EV-10449.

Descriptors: *Polychlorinated dibenzo-p-dioxins, *Water pollution sources, *Chlorinated hydrocarbons, *Hydrocarbons, *Aquatic environment, Polychlorinated dibenzofurans, Great Lakes, Lake Huron, Gas chromatography, Mass spectrometry, Water analysis, Chemical analysis.

Sediment core sampling was used in a study designed to assess the historical input of combustion-generated polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF) into the environment. The goal of the investigation was to determine whether these compounds (including some highly toxic isomers) are formed primarily from the pyrolysis of chlorinated aromatic precursors present in the fuel or are formed during the combustion of naturally occurring organic materials. Four core samples from southern Lake Huron were extracted with isopropanol followed by methylene chloride, and final extracts were analyzed by gas chromatographic mass spectrometry

using methane-negative chemical ionization. This technique allows determination of PCDD and PCDF at low parts per trillion levels. The most abundant species tended to be the highly chlorinated PCDD and PCDF, with octachlorodioxin predominating in all samples. There was no evidence of degradation of PCDD or PCDF. Depth vs. concentration profiles show that the input of these two compounds increased dramatically in approximately 1940, which corresponds to an increased production of chlorinated aromatic compounds, including those used in herbicides and wood preservatives. Thus, combustion of municipal waste is suggested as a major source. It was concluded that the high levels found do not reflect natural combustion processes, but rather anthropogenic combustion, primarily combustion of chlorinated precursors present in combustion fuels. (Halterman-PTT)
W86-02241

ANALYSIS OF PCDD-PCDF IN ENVIRONMENTAL SAMPLES,
Department of the Environment, Ottawa (Ontario).
R. C. Lao, R. S. Thomas, C. Chiu, and K. Li.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Buttworth Publishers, Boston, 1985. p65-78, 7 fig, 6 tab, 11 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Water pollution sources, *Aquatic environment, *Water analysis, Wastewater, Sludge disposal, Industrial wastes, Gas chromatography, Mass spectrometry, Polychlorinated dibenzo-dioxins, Polychlorinated dibenzofurans, Chemical analysis, Ecosystems.

Several environmental sources were analyzed for polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) in an effort to identify more actual or potential PCDD-PCDF pathways to the environment. The samples analyzed were: aquatic discharges from wood preservative plants; influent raw sewage, wastewater effluents and exhaust gases from a sludge incinerator; effluent gas stream from a coal preparation plant; gaseous effluent and the cooling water stream from a plasma hydrolysis process (a prototype apparatus for destruction of organic halide waste); gaseous samples from open-air wire insulation burning; and exhaust gases from a hospital waste incinerator. Analysis was by gas chromatography-mass spectrometry, using the Townsend discharge technique. One or more PCDD-PCDF compounds were present in all samples. The concentrations, extent of chlorination and isomeric distributions were notably dependent on the feedstock and destruction process, and on operational parameters. An array of PCDD-PCDF was identified in main effluent discharge from the wood preservation plant and was also readily identified at 0.8 km downstream from the discharge, although at a remarkably reduced level. In the sludge-burning samples, the preliminary mass-balance calculations suggest that sludge accumulates all the PCDD-PCDF, and the resultant mass loading to the incinerator is about 1 gm/day. (Halterman-PTT)
W86-02242

OCTANOL-WATER PARTITION COEFFICIENT OF 1,3,6,8-TCDD AND OCDD BY REVERSE PHASE HPLC,
Manitoba Univ., Winnipeg. Dept. of Soil Science.
G. R. B. Webster, L. P. Sarna, and D. C. G. Muir.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Butterworth Publishers, Boston, 1985. p 79-87, 2 fig, 2 tab, 6 ref. OSU 82-00277.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Water pollution sources, *Chemical analysis, *Aquatic environment, Chromatography, Octachlorodibenzo-p-dioxin, 1,3,6,8-tetrachlorodibenzo-p-dioxin, Water analysis.

To enable the environmental dynamics of the chlorinated dioxins octachloro-dibenzo-p-dioxin (OCDD) and 1,3,6,8-tetrachlorodibenzo-p-dioxin (1,3,6,8-TCDD) to be obtained by simple modeling calculations, key physical properties were determined. The porperties studied were octanol-water partition coefficient and water solubility, since these are closely related to a substance's ability to pass through biological membranes and bioaccumulate or to partition between environmental media. A reversed-phase high-performance liquid chromatography method for determination of these two properties is presented. Since standard methods are not effective with these hydrophobic substances, a modification using a quadratic equation is presented. The data presented indicate that the quadratic-derived values of the log of the octanol-water partition coefficient for both 1,3,6,8-TCDD and OCDD agree with the water solubility-determined values very well. (Halterman-PTT)
W86-02243

BIOAVAILABILITY OF 14C-1,3,6,8-TETRACHLORODIBENZO-P-DIOXIN AND 14C-OCTACHLORODIBENZO-P-DIOXIN TO AQUATIC INSECTS IN SEDIMENT AND WATER,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W86-02244

ANALYSIS OF POLYCHLORINATED DIBENZOFURANS AND DIOXINS IN ECOLOGICAL SAMPLES,
Umea Univ. (Sweden). Dept. of Organic Chemistry.
C. Rappe, P. A. Bergqvist, and S. Marklund.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Butterworth Publishers, Boston, 1985. p 125-138, 8 fig, 5 tab, 16 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Chemical analysis, *Aquatic environment, Polychlorinated dibenzo-p-dioxin, Polychlorinated dibenzofuran, Gas chromatography, Fish, Herring, Baltic Sea.

The need for a highly sensitive and specific analytical technique for the measurement of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibensofurans (PCDF) is emphasized, and the requirements to be met by such a method are discussed. A recovery study of the cleanup system analyzing fish samples fortified at three different spiking levels using synthetic PCDD and PCDF standard is reported. The PCDF and PCDD were extracted and separated from interfering substances in two series of sequential chromatographic processes. Detection was accomplished by gas chromatography-mass spectrometry. Recoveries of the various isomers at spiking levels of 0, 20 and 100 ppt are reported. In addition, studies on the elution order of the same isomers on an alumina column are presented. Also included are results from analyses of herring and guillemot samples from the Baltic Sea. A series of PCDD and PCDF has been identified in these samples at the ppt level. (Halterman-PTT)
W86-02246

ANALYSIS OF PCBS USING SPECIFIC ISOMER HIGH RESOLUTION CAPILLARY GAS CHROMATOGRAPHY,
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
M. D. Mullin, C. Pochini, S. H. Safe, and L. M. Safe.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 165-176, 4 fig, 3 tab, 30 ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish, Gas chromatography, Chromatography.

The problems associated with the toxicology and analytical chemistry of polychlorinated biphenyls (PCBs) are primarily due to the large numbers of theoretically possible isomers. The toxicity of PCBs is a function of the structure of the individual isomer. It is not sufficient to quantify the total amount of PCBs present in an environmental sample; the concentrations of the isomers which are potentially more toxic must also be determined. High resolution gas chromatographic analytical techniques are outlined and examples of resultant chromatograms are presented. The use of high resolution capillary gas chromatography, in conjunction with the use of PCB isomers as reference standards, is presently a viable analytical technique for the analysis of commerical PCB formulations and environmental samples from many different matrices. (Halterman-PTT)
W86-02254

WATER ANALYSIS, VOLUME 1: INORGANIC SPECIES, PART 1,
Academic Press, Inc., Orlando, FL. 1982. Edited by Roger A. Minear and Lawrence H. Keith. 287 p.

Descriptors: *Water analysis, *Reviews, *Trace elements, *Inorganic compounds, *Theoretical analysis, Organic compounds, Alkalinity, Acidity, Conductance, Dissolved soilds, Oxidation-reduction potential, Turbidity, Water quality, Natural waters, Wastewater analysis.

This volume is the first of three volumes designed to present both the theoretical and the practical aspects of understanding and determining the trace-level components that are found in all natural, pristine, and polluted waters. Volume I is the first of two focusing on the inorganic constituents in water. The first chapter presents a background on the inorganic constituents found in water. A general treatment of the sources of representative species found in both natural waters and wastewaters is followed by a discussion on the effects of hydrolysis, complexation, and dissolution in conjunction with redox and pH in the environmental dynamics of these species. Chapters 2 and 3 include a detailed discussion of these topics. The fourth chapter deals with conductance, a general measure of solution ionic content. The in-depth treatment of light scattering theory principles in Chapter 5 is intended to give the reader a sufficient understanding of the complexity of turbidimetric responses. Chapter 6 concludes the volumen with a survey of general water quality analytical procedures used for measuring individual inorganic species. (Geiger-PTT)
W86-02257

REDOX POTENTIAL: ITS MEASUREMENT AND IMPORTANCE IN WATER SYSTEMS,
Maryland Geological Survey, Baltimore.
For primary bibliographic entry see Field 2K.
W86-02259

ALKALINITY AND ACIDITY,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W86-02260

CONDUCTANCE: A COLLECTIVE MEASURE OF DISSOLVED IONS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 1B.
W86-02261

THEORY AND MEASUREMENT OF TURBIDITY AND RESIDUE,
Hach Co., Loveland, CO.
For primary bibliographic entry see Field 2K.
W86-02262

SUMMARY OF METHODS FOR WATER-QUALITY ANALYSIS OF SPECIFIC SPECIES,
Geological Survey, Arvada, CO. Water Resources Div.
H. E. Taylor.
IN: Water Analysis, Academic Press, Orlando, FL, 1982, Volume 1: Inorganic Species, Part 1. 1982, p 235-273, 2 fig, 7 tab, 42 ref.

Descriptors: *Water analysis, *Water quality, *Chromatography, *Electrochemistry, *Pollutant identification, *Spectrophotometry, Chemical

properties, Wastewater analysis, Natural waters, Gas chromatography, Conductance, Potentiometers, Mass spectrometry, Photometry, X-ray spectroscopy.

In the past 20 years, a variety of methods have been developed to solve specific analytical water quality problems. Several categories of analysis are available depending on the objective of the application. These are: qualitative, semiquantitative, and quantitative. Most modern methods of instrumental analysis base their quantitation on the method of direct comparison wiih a synthetic standard or a known concentration reference material for standardization. Classical methods are generally considered to be in one of two categories, either gravimetric or volumetric analysis. Usually classical method are not employed in the modern water quality laboratory because of their time requirements. Spectroscopic methods of analysis can be broken down into two major categories - absorption techniques and emission or fluorescence techniques. Molecular and atomic absorption methods are described. Emission methods examined include atomic emission, molecular emission, atomic fluorescence, x-ray fluorescence, neutron activation, and mass spectrometry. Electrochemical methods of water analysis can be grouped into several different categories. They include: potentiometric techniques, voltammetric techniques, amperometry, and conductance techniques. Chromatography is one of the most effectively known methods of separating interfering constituents prior to analysis. The principles of chromatographic analysis are described. (Geiger-PTT)
W86-02263

GEOCHEMICAL IDENTIFICATION OF SALINITY SOURCES,
Kansas State Geological Survey, Lawrence.
D. O. Whittemore.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 505-514, 5 fig, 14 ref.

Descriptors: *Saline water, *Salinity, *Water pollution sources, *Pollutant identification, *Brines, Oil field brines, Chemical analysis, Dissolved solids, Isotope studies, Kansas.

The assessment of the concentrations and ratios of dissolved constituents and isotopes to identify salinity sources is described. For instance, values of Na/Cl weight ratios are 0.5 for oil-field brines in Kansas, and 0.65 for salt-solution brines in near-surface Permian rocks. The significance of ratios of B/Cl, Li/Cl, Br/Cl, and I/Cl are also discussed. Major sources of salinity in Kansas, including near-surface evaporate solutions and oil-field brines, are described. Case histories of salinity source identification are outlined, including those from Smokey Hill River Valley, Great Bend Prairie, Equus Beds, and the Blood Orchard area. (Halterman-PTT)
W86-02309

QUALITY OF GROUND WATER IN THE PRINCIPAL AQUIFERS OF NORTHEASTERN-NORTH CENTRAL WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02345

PRELIMINARY ANALYSIS OF GEOHYDROLOGIC DATA FROM TEST WELLS DRILLED NEAR CHESTER, ON KENT ISLAND, QUEEN ANNES COUNTY, MARYLAND,
Maryland Dept. of Natural Resources, Annapolis.
F. K. Mack.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 82-854, 1983. 31 p, 11 fig, 4 tab, 12 ref.

Descriptors: Groundwater, Geohydrologic units, *Water wells, Coastal Plain, *Water quality, Water temperature, *Aquifer testing, Borehole geophysics, Hydrographs, *Maryland, *Queen Annes County, Kent Island.

A test hole drilled on Kent Island, Queen Annes County, Maryland, to a depth of 2548 feet, penetrated 2518 feet of Coastal Plain sediments and 30 feet of the underlying bedrock. Drill cuttings, cores, and geophysical logs were used to identify five aquifers: the Patuxent, lower Patapsco, upper Patapsco, Magothy, and Aquia. Water samples and pumping test data obtained from wells completed in the aquifers wre used to determine the water quality and transmissivities of the aquifers. Transmissivity of each, in feet squared per day, was found to be >800, 1,400, 4,000, 5,800, and >320 respectively. Chemical analyses showed that water from each aquifer is fresh and is distinctly different in chemical character from the others. Iron exceeded the limit recommended by EPA for drinking water in each of the aquifers. Water in the deeper aquifers is soft but water in the Aquia aquifer has a hardness of 160 milligram/Liter. Water levels in the wells are (1) affected by tidal changes in nearby estuaries of Chesapeake Bay, and (2) are highest in the deepest aquifer (16 feet above sea level) and progressively lower in each of the shallower aquifers. (USGS)
W86-02349

ANALYSIS OF GROUND-WATER-QUALITY DATA IN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02361

CHEMICAL AND ISOTOPIC CHARACTERISTICS OF BRINES FROM THREE OIL- AND GAS-PRODUCING FORMATIONS IN EASTERN OHIO, WITH APPLICATIONS TO THE GEOCHEMICAL TRACING OF BRINE SOURCES,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02365

GROUND-WATER QUALITY DATA FOR THE ATLANTIC COASTAL PLAIN: NEW JERSEY, DELAWARE, MARYLAND, VIRGINIA, AND NORTH CAROLINA,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02374

5B. Sources Of Pollution

DATA ON SURFACE-WATER QUALITY AND QUANTITY, TRUCKEE RIVER SYSTEM, NEVADA AND CALIFORNIA, 1979-81,
Geological Survey, Carson City, NV. Water Resources Div.
R. J. La Camera, R. J. Hoffman, J. O. Nowlin, L. H. Smith, and S. M. Lima.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-238, 1985. 191 p, 2 fig, 36 tab, 17 ref.

Descriptors: *Channel morphology, *Synoptic analysis, *Travel time, *Water quality, *Water temperature, Aeration, Dyes, Interstitial water, Phytoplankton, Tracers, *Truckee Canal, *Truckee River, *California, *Nevada.

Selected hydrologic data were collected between May 1979 and October 1981 at 59 sites on the Truckee River, 10 sites on selected tributaries and smaller diversions, and 9 sites on the Truckee Canal. The data were collected in support of the water-quality and hydrologic investigation components of the Truckee-Carson River-Quality Assessment by the U.S. Geological Survey. This report contains data from: (1) diel and antecedent measurements made in conjunction with four synoptic water-quality studies, (2) analyses of phytoplankton samples to supplement other biological data collected during the synoptic studies, (3) an investigation of surface and intragravel water quality to determine the suitability of the river as a spawning habitat for Lahontan cutthroat trout, (4) 10 water-temperature recorders, (5) 11 dye-tracer studies, (6) 5 gas-tracer reaeration studies, (7) summaries of dye-tracer travel times derived from the dye and reaeration studies, and (8) discharge measurements with associated channel-geometry descriptions at 46 miscellaneous sites on the river, selected tributaries, and the canal. (USGS)
W86-01924

COMPUTER MODEL OF ONE-DIMENSIONAL EQUILIBRIUM CONTROLLED SORPTION PROCESSES,
Geological Survey, Denver, CO. Water Resources Div.
D. B. Grove, and K. G. Stollenwerk.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4059, 1984. 58 p, 15 fig, 2 tab, 9 ref.

Descriptors: *Water pollution, *Computer models, *Mathematical models, Groundwater, Ion transport, Ion exchange, Chemical reactions, *Groundwater movement, Sorption processes, *Finite-difference methods, *Path of pollutants.

A numerical solution to the one-dimensional solute-transport equation with equilibrium-controlled sorption and a first-order irreversible-rate reaction is presented. The computer code is written in FORTRAN language, with a variety of options for input and output for user ease. Sorption reactions include Langmuir, Freundlich, and ion-exchange, with or without equal valance. General equations describing transport and reaction processes are solved by finite-difference methods, with nonlinearities accounted for by iteration. Complete documentation of the code, with examples, is included. (USGS)
W86-01925

TEST WELL INSTALLATION AND WATER QUALITY, HOLLYWOOD DUMP AREA, MEMPHIS, TENNESSEE,
Geological Survey, Memphis, TN. Water Resources Div.
D. D. Graham.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4214, 1985. 35 p, 10 fig, 4 tab, 12 ref.

Descriptors: *Landfills, *Groundwater contamination, Aquifers, Water quality, *Tennessee, Memphis, Waste pollution sources, Path of pollutants.

The Hollywood Dump in north Memphis, Tennessee is known to contain hazardous wastes. Monitor wells were installed and sampled to determine if contaminants have entered the underlying Wolf River alluvium and concentrated near the base of this unconfined aquifer. Four water-quality samples were collected from each of nine monitor wells screened in the Wolf River alluvium at the Hollywood Dump between June 1982 and June 1983. Also sampled during this period was one well screened in the fluvial (terrace) deposits, about one-half mile upgradient from the dump, and three nearby wells screened in the Memphis Sand artesian aquifer. Low levels of several organic compounds, including heptachlor, chlordane and chlordene, were detected in water from the Wolf River alluvium. High concentrations of barium and arsenic were also detected. Water from the Memphis Sand showed no traces of synthetic organic compounds. Other constituents and properties were found to be at levels that are normal for that aquifer. Five of the Wolf River alluvium wells sampled were newly installed. Geophysical logs made in these wells, supplemented by drillers logs and split spoon samples, show that clay underlies the alluvial aquifer at the well locations. (USGS)
W86-01928

GROUND-WATER HYDROLOGY OF VOLUSIA COUNTY, FLORIDA, WITH EMPHASIS ON OCCURRENCE AND MOVEMENT OF BRACKISH WATER,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01932

HYDROLOGY OF AREA 11, EASTERN COAL PROVINCE, OHIO, KENTUCKY, AND WEST VIRGINIA,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-01937

OCCURRENCE OF SALINE WATER IN THE ALLUVIAL AQUIFER IN THE BOEUF-TENSAS BASIN, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
D. J. Fitzpatrick.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4029, 1985. 1 sheet, 3 fig, 1 tab, 10 ref.

Descriptors: *Groundwater pollution, Water quality, *Saline water intrusion, Aquifers, Groundwater, *Arkansas, Gulf Coastal Plain, Boeuf-Tensas basin.

The occurrence of saline water in the alluvial aquifer in the Boeuf-Tensas basin in southeastern Arkansas has been of increasing concern. A band of saline water containing chloride concentrations of greater than 50 milligrams per liter extends through the entire length of the basin. The most severely affected area is located in the southern part of the basin where chloride concentrations are as high as 1,360 milligrams per liter. The origin of the saline water in the alluvial aquifer is not definitely known, but can probably be attributed at least in part, to both upward movement from the Arkansas River. Upward instrusion of saline ground water has probably occurred through one or more of the following: 1) leakage where the Jackson confining unit is thinned or absent, 2) leakage along a fault, and 3) movement through abandoned oil and gas test holes. (USGS)
W86-01940

NITROGEN, SULFATE, CHLORIDE, AND MANGANESE IN GROUND WATER IN THE ALLUVIAL DEPOSITS OF THE SOUTH PLATTE RIVER VALLEY NEAR GREELEY, WELD COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
N. G. Gaggiani.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4088, 1984. 2 sheets, 6 fig, 15 ref.

Descriptors: *Groundwater pollution, *Alluvial aquifers, *Water quality, Feedlots, Irrigation effects, Groundwater irrigation, Groundwater recharge, Chlorides, Nitrates, Sulfates, Manganese, *Colorado, *Cattle wastes, *Valley-fill deposits, South Platte River Valley, Kersey.

Ground water from the valley-fill deposits of the South Platte River Valley and its tributaries is used extensively for agriculture in the study area, about 10 miles east of Greeley and about 50 miles northeast of Denver, Colorado. The valley-fill deposits, which consist of alluvial and terrace deposits, are in a valley system eroded in Laramie Formation bedrock. Water samples collected from 53 wells during 1974 and 1980 were analyzed for nitrite plus nitrate nitrogen, sulfate, chloride, and manganese. Median concentrations changes in these constituents from 1974 to 1980 are as follows: 6.0 to 8.8 milligrams per liter for nitrite plus nitrate nitrogen, 850 to 900 milligrams per liter for sulfate, and 94 to 120 milligrams per liter for chloride. Manganese concentrations were greater than 1,000 micrograms per liter in both 1974 and 1980 in a small area at the mouth of Box Elder Creek. (USGS)
W86-01941

EFFECTS OF URBANIZATION OF THREE PONDS IN MIDDLETON, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-01949

CHEMICAL QUALITY OF WATER AT 14 SITES NEAR KESTERSON NATIONAL WILDLIFE REFUGE, FRESNO AND MERGED COUNTIES, CALIFORNIA,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
J. A. Izbicki.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-582, 1984. 17 p, 1 fig, 2 tab, 2 ref.

Descriptors: *Irrigation-return flow, *Water pollution sources, trace elements, Trace metals, Water quality, *Kesterson Reservoir, West Side San Joaquin Valley, San Luis Drain, *California, Agricultural drainage.

Data were collected to determine concentrations of major ions, nutrients, and selected trace elements in collector drains tributary to the San Luis Drain; the San Luis Drain near Kesterson Reservoir; Kesterson Reservoir; and selected drains, canals, and sloughs near but not tributary to Kesterson Reservoir, California. Results from 14 samples collected during January 24-26, 1984, are summarized in tables, and the sample locations are shown on maps. (USGS)
W86-01959

SIMULATED EFFECTS OF SURFACE COAL MINING AND AGRICULTURE ON DISSOLVED SOLIDS IN ROSEBUD CREEK, SOUTHEASTERN MONTANA,
R. F. Ferreira.
Available from OFSS, USGS BOX 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4101, 1984. 94 p, 4 fig, 25 tab, 43 ref.

Descriptors: *Coal mines, Strip mines, Dissolved solids, *Water pollution sources, irrigation effects, *Simulation analysis, *Surface mining, Rosebud Creek, *Montana.

Dissolved-solids concentrations in five reaches of Rosebud Creek in southeastern Montana were simulated to assist in evaluating the effects of surface coal mining and agriculture on the dissolved-solids concentration. A mass balance of streamflow and dissolved-solids load was used. Mined acreage, dissolved-solids concentrations in mined spoils, and irrigated acreage were varied in the model to study relative changes in the dissolved-solids concentration of each reach of Rosebud Creek. Both simulated monthly streamflow and dissolved-solids load generally are within the 95-percent confidence limits of the mean monthly values calculated for Rosebud Creek at the mouth near Rosebud, Montana. From May through September, the simulated mean monthly streamflows vary by no more than 15 percent of the historical mean values. Except for January, May, and December, the simulated mean monthly dissolved-solids loads vary by no more than 13 percent of the historical mean values. Simulations based on present mining show irrigation accounting for a larger cumulative percentage of dissolved-solids concentration (3.05 percent in reach 5) than mining (0.38 percent in reach 5). However, with full-scale mining, the cumulative percentage resulting from irrigation in reach 5 (2.50 percent) will be smaller than that resulting from mining (14.69). By not simulating mining of the Kirby coal deposit in reach 1, the cumulative percentage of dissolved-solids concentration resulting from mining in all reaches will be decreased to less than 6.00 percent.
W86-01962

COMPILATION OF DATA COLLECTED AND DERIVED FOR WATER YEARS 1980 AND 1981 FOR THE PURPOSE OF WATER-QUALITY MODELING OF THE LOWER OUACHITA RIVER AND SELECTED TRIBUTARIES, SOUTH-CENTRAL ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
J. C. Petersen, and E. E. Morris.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-727, 1984. 130 p, 16 fig, 40 tab, 36 ref.

Descriptors: *Hydrologic data collection, *Water quality, *Dissolved oxygen, *Nutrients, Coliform, Stream discharge, Algae, Phytoplankton, Chlorophyll, *Arkansas, *Ouachita River, Periphyton, Stream geometry.

This report represents water-quality, sediment oxygen demand, phytoplankton, periphyton, bacteria, instantaneous and mean-daily discharge, stream geometry, time of travel, reaeration data and other water quality collected on the lower Ouachita River (from just upstream of Little Missouri River to Lock and Dam 6), West Two Bayou, Smackover Creek, Haynes Creek and selected tributaries. The data were collected primarily between August 1980 and September 1981. Over 100 sites were sampled, but most were sampled only during two intensive sampling periods in mid-August of 1980 and mid-September of 1981. The water-quality data include measurements of pH, specific conductance, dissolved oxygen, water temperature, whole-water nitrogen species, total phosphorus, total orthophosphorus, dissolved chlorides, dissolved sulfate, ultimate biochemical oxygen demand and organic carbon. The phytoplankton and periphyton data include measurements of chlorophyll a and b, taxonomic identification cell counts and weights. Limited precipitation data are also included. Maps and schematic diagrams of the lower Ouachita River, West Two Bayou, Smackover Creek and Haynes Creek drainage systems show the location of the data-collection sites within the area. (USGS)
W86-01965

GEOCHEMICAL PROCESSES IN THE GASCOYNE LIGNITE MINING AREA, BOWMAN COUNTY, NORTH DAKOTA,
Geological Survey, Reston, VA. Water Resources Div.
D. W. Fisher, D. C. Thorstenson, M. G. Croft, and R. L. Houghton.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4192, 1985. 80 p, 15 fig, 15 tab, 32 ref.

Descriptors: *Strip mines, *Water quality, *Groundwater, Chemical reactions, Carbon radioisotopes, Carbonates, Cation exchange, Aeration zone, *Coal mining effects, *Fort Union formation, *North Dakota, Dissolved gases, Gas analyses, Sulfate reduction.

A study was begun in 1975 to determine the geochemical processes that have affected groundwater quality as a result of a lignite strip mine at Gascoyne, North Dakota. Ground waters and surface waters on or near the mine were analyzed for major and minor dissolved constituents, tritium and carbon-13 isotopes, and dissolved gases. Compositions and carbon isotopes were determined in gas samples from various horizons at six unsaturated-zone sites. Mineralogic and cation-exchange data were obtained from core samples and surface solids from the mine and from nearby farms. Reactions that control ground-water chemistry at the mine include: (1) Oxidation of organic matter and ferrous iron minerals in the saturated zone; (2) Dissolution of C02, carbonates and sulfates in unsaturated-zone water; (3) Cation exchange reactions on clays and on lignite; (4) Sulfate reduction and pyrite deposition in the lignite; (5) leaching of halides and of organic matter from the lignite; and (6) Silicate hydrolysis near the lignite outcrop. Gascoyne area ground waters are near neutral to moderately alkaline sodium sulfate solutions containing several hundred to several thousand mg/L dissolved sulfate. Mining operations will probably increase the dissolved sulfate levels in the groundwater reservoir at Gascoyne. (USGS)
W86-01970

RESULTS OF THE SEPARATIONS AREA GROUND-WATER MONITORING NETWORK FOR 1981,
Atomics International Div., Richland, WA. Energy Systems Group.
J. S. Wilbur, and M. J. Graham.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-020562,

Price codes: A03 in paper copy, A01 in microfighe. Report RHO-HS-SR--5P, July 1982. 43 p, 18 fig, 4 tab, 10 ref, 6 append. DE-AC06-77RL01030.

Descriptors: *Fate of pollutants, *Water pollution sources, *Radioactive wastes, *Radioisotopes, Tritium, Monitoring, Water quality, Groundwater pollution, Hanford Site, Nuclear reactors, *Washington.

Results of the 1981 groundwater monitoring program at the Rockwell Hanford Site Separations Area indicated few changes from 1980. Samples from monitoring wells were analyzed for total alpha, total beta, Co60, Ru106, Cs137, Sr90, tritium, uranium, and nitrate. Tritium levels exceeded the guidelines for tritium (3000 pCi/m1) iin three wells which monitor active sites. With the exception of tritium, all contamination greater than 10% of the guidelines was caused by past disposal to inactive sites. The zone of contamination appears stable and highly localized for the sites represented by these samples. Groundwater migrating out of the Separations Area at this time contain pollutants at levels less than the guidelines. (Cassar-PTT)
W86-01977

ASSESSMENT AND CONTROL OF WATER CONTAMINATION ASSOCIATED WITH SHALE OIL EXTRACTION AND PROCESSING,
Los Alamos National Lab., NM.
E. J. Peterson, A. V. Henicksman, J. P. Fox, J. A. O. O'Rourke, and P. Wagner.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82 019186, Price codes: A03 in paper copy, A01 in microfiche. Report LA-9084-PR; UC-91, April 1982. 48 p, 8 fig, 23 tab, 24 ref, 3 append.

Descriptors: *Water quality control, *Oil shale, Shales, Trace elements, Metals, Heavy metals, Leaching, *Water pollution sources.

Laboratory studies on the potential water contamination associated with oil shale operations, focus on the mineralogy, trace element concentrations in solids, and leaching characteristics of raw and spent shales. Process parameters in modified in situ retorting are extreme. Mineralogic characterization of field generated spent shales indicate that carbonate decomposition and silication reactions occurred in Retort 3E at Logan Wash, Colorado. However, evaluation of leachate compositions indicate that several environmentally sensitive trace elements, including K, Li, F, V, Pb, B, Mo, Ni, Se, and As are not rendered immobile by in situ processing and could be of environmental concern. These conclusions are verified by investigations of laboratory-generated spent shales. This report details the chemical, mineralogic, and solution behavior of major, minor, and trace elements in a variety of shale materials. Control technology research activities have focused on the definition of control technology requirements based on assessment activities and laboratory evaluation of alternative control strategies for mitigation of identified problems. The overall impact of in situ processing on groundwater quality appears to be less significant than previously believed. Most elements leached from spent shales are already elevated in most groundwaters. Analysis indicates that solubility controls by major cations and anions will aid in mitigating water quality impacts with the exception of V, Pb, and Se. With respect to in situ retort leaching, process control and multistaged counterflow leaching are evaluated as control strategies. (Cassar-PTT)
W86-01979

MECHANISMS FOR GROUNDWATER CONTAMINATION BY UCG: PRELIMINARY CONCLUSIONS FROM THE HOE CREEK STUDY,
Lawrence Livermore National Lab., CA.
F. T. Wang, S. W. Mead, and D. H. Stuermer.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-020348, Price codes: A02 in paper copy, A01 in microfiche. Report UCRL--88012, August 3, 1982. 12 p, 6 fig, 5 tab, 5 ref. W-7405-E-48.

Descriptors: *Water pollution sources, *Fate of pollutants, *Water quality control, *Coal gasification, Gasification, Pyrolysis, Hoe Creek, Wyoming, Groundwater pollution, Organic compounds, Ammonia, Leaching.

Changes in groundwater quality were monitored in 60 wells drilled near the three underground coal gasification experiments at Hoe Creek, Wyoming. Five mechanisms were proposed to explain how residual gasification products were introduced into groundwater. (1) Escaping hot product gases may pyrolyze surrounding coal along its natural cracks. This is most likely to happen in an overlying aquifer. However, sand layers are not readily contaminated in this manner. If this mechanism is valid, dewatering wells could lower system pressure and reduce the volume of escaping product gas. (2) After gasification, the residual heat inside the cavity produces further pyrolysis products. (3) Leaching of coal ash by returning groundwater liberates inorganic contaminants. (4) Overburden materials heated to various degrees are the source of inorganic substances which enter the groundwater. (5) Minerals are dissolved by carbon dioxide escaping from the cavity during gasification. These possible mechanisms may be considered in designing monitoring networks and control technologies. For example, in leaky coal seams, monitoring wells should be 100 m or more from the cavity. In a thick coal seam, some wells should be completed in the top portion of the bed. Contaminated groundwater may be treated by pumping water to the surface through a wall in the cavity. The quantity of pyrolysis products can be minimized by preventing gas losses. (Cassar-PTT)
W86-01981

SEDIMENT AND RADIONUCLIDE TRANSPORT IN RIVERS: FIELD SAMPLING PROGRAM FOR CATTARAUGUS AND BUTTERMILK CREEKS, NEW YORK,
Battelle Pacific Northwest Labs., Richland, WA.
W. H. Walter, R. M. Ecker, and Y. Onishi.
Report PNL-3117, Vol. 4, Summary Report. November 1982. 75 p, 41 fig, 10 tab, 6 ref, 2 append.

Descriptors: *Path of pollutants, *Radioactive wastes, *Surface waters, *Radionuclides, *Radioisotopes, Cesium-137, Strontium-90, Plutonium, Americum, Tritium, Curium, Rivers, Sediments, Transport, Buttermilk Creek, *New York.

A field sampling program was conducted on the Buttermilk-Cattaraugus Creek system, New York, to investigate the transport of radionuclides in surface waters as part of a continuing program to provide data for application and verification of Pacific Northwest Laboratory's (PNL) sediment and radionuclide transport model, SERATRA. Based on the evaluation of radionuclide levels in Cattaraugus and Buttermilk Creeks, the Nuclear Fuel Services facility at West Valley, New York, may be the source of Cs-137, Sr-90, Cs-134, Co-60, Pu-238, Pu-239, 240, Am-241, Cm-244 and tritium found in the bed sediment, suspended sediment and water of Buttermilk and Cattaraugus Creeks. Bed sediment, suspended sediment, and water samples were collected over a 45-mile reach of the creek system. Bed sediment samples were also collected at the mouth of Cattaraugus Creek in Lake Erie. Radiological analysis of these samples included gamma ray spectrometry analysis, and radiochemical separation and analysis of Sr-90, Pu-238, Pu-239, 240, Am-241 and Cm-244. Tritium analysis was also performed on water samples. (Author's modified abstract)
W86-01988

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN GROUNDWATER MODELING: SELECTION, TESTING AND USE,
Michigan Dept. of Natural Resources, Lansing.
D. A. Hamilton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-143206, Price codes: A09 in paper copy, A01 in microfiche. Volume 1, September 1982. 199 p, 98 fig, 6 tab, 62 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Groundwater management, *Model studies, *Michigan, AQUIFEM model, Mass transport, Groundwater movement, Groundwater pollution, Aquifers, Mathematical models, Water quality, Water pollution, Water quality control, Management.

Groundwater models were applied to three field problems in Michigan: a landfill leachate plume, contamination from an unknown source, and domestic wells contaminated with chromium from an industrial plant. The AQUIFEM model was tested at all three sites. Three different models (AQUIFEM, GEOFLOW, and the U.S.G.S. mass transport model) were applied to the chromium pollution situation. AQUIFEM was recommended as the first model to use in a given problem. Mass transport modeling should be attempted only if site complexity, project demand, and a large body of available data require this model type. Some of the uses of groundwater modeling demonstrated in this study include testing working hypotheses, directing where new data should be obtained, simulating various management alternatives, and coordinating the final design with management implementation. (Cassar-PTT)
W86-01989

RESEARCH PROGRAM FOR ATMOSPHERIC CHEMISTRY, RADIATION AND DYNAMICS,
Atmospheric and Environmental Research, Inc., Cambridge, MA.
N. D. Sze, M. K. W. Ko, M. Livshits, W. C. Wang, and P. B. Ryan.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120407, Price codes: A06 in paper copy, A01 in microfiche. Report No. AFGL-TR-82-0207, Final Report, July 1982. 121 p, 50 fig, 5 tab, 115 ref, 2 append. F19628-81-C-0016.

Descriptors: *Chemical reactions, *Atmosphere, Model studies, Ozone, Metals, Heavy metals, Nitrogen oxides, *Acid rain, *Path of pollutants, Water pollution sources, *Atmospheric chemistry.

Progress is summarized in atmospheric research conducted under AFGL contract F19628-81-C-0016 for the period December 1980 to June 1982. Four topics are discussed. (1) New rates for the reactions of OH with HNO3 and HNO4 introduce additional coupling between HOx and NOx species, reducing the OH and HO2 concentrations in the lower stratosphere. (2) The calculated steady state ozone depletion due to continued release of fluorocarbons at the 1977 production level is 6.1%, compared with the depletion rate (16.4%) calculated from 1979 rates. Ozone perturbations due to human activity may interact in nonlinear fashion. For example, an increase in atmospheric carbon dioxide may partially offset the fluorocarbon-induced ozone perturbation. (3) The AER two-dimensional model results were compared with observations of atmospheric gases. Important discrepancies still exist in ClO and some fluorocarbons. (4) Studies on meteoric metals in the atmosphere indicate that metal species have the potential to couple to other chemical cycles and change radical species concentrations. (Cassar-PTT)
W86-01996

PHYSICAL BEHAVIOR OF PCBS IN THE GREAT LAKES.
For primary bibliographic entry see Field 5A.
W86-02012

VAPOR EXCHANGE OF PCBS WITH LAKE MICHIGAN: THE ATMOSPHERE AS A SINK FOR PCBS,
De Paul Univ., Chicago, IL.
T. J. Murphy, J. C. Pokojowczyk, and M. D. Mullin.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 49-58, 3 tab, 10 ref. CR-807412.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Atmosphere, *Vaporization, *Lake Michigan, Great Lakes, Henry's law constants, Chlorobiphenyls, Gas chromatography, Aroclors.

Research was conducted to answer the question of whether there is net transport of PCB vapor into or out of the water, a major problem remaining in determining the PCB budgets of the Great Lakes. These studies indicate that the net movement of PCB vapor is from the water to the atmosphere. The methods used to draw these conclusions involve determining the ratios of PCB concentrations in solution and in vapor above the solution. The ramifications of the results of this work with regard to precipitation are as follows: a water concentration of 1 ng/l of a PCB with Henry's law constant (HLC of 0.00033 atm-cu m/mol) will support a vapor PCB concentration of 13.3 ng/cu m. Thus, precipitation in equilibrium with an atmospheric vapor concentration of 2 ng/ cu m of PCB, will have a dissolved PCB concentration of 0.15 ng/1. This is a concentration two orders of magnitude or more lower than is normally found in precipitation and indicates that vapor scavenging can account for less than 1% of the wet deposition PCB inputs. (Halterman-PTT)
W86-02014

PHYSICAL CHEMICAL PROPERTIES OF POLYCHLORINATED BIPHENYLS,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
For primary bibliographic entry see Field 5A.
W86-02015

REACTIVITY AND ENVIRONMENTAL PERSISTENCE OF PCB ISOMERS,
Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab.
For primary bibliographic entry see Field 5A.
W86-02016

REVERSIBLE AND RESISTANT COMPONENT MODEL OF HEXACHLOROBIPHENYL ADSORPTION-DESORPTION RESUSPENSION AND DILUTION,
Manhattan Coll., Bronx, NY. Dept. of Environmental Engineering and Science.
For primary bibliographic entry see Field 5A.
W86-02017

PCBS IN THE LAKE SUPERIOR ATMOSPHERE 1978-1980,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5A.
W86-02018

PROCESSES DETERMINING THE FLUX OF PCBS ACROSS AIR/WATER INTERFACES,
Wisconsin Univ.-Madison.
A. W. Andren.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 127-140, 1 fig, 4 tab, 39 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Lake Michigan, Great Lakes, Air-water interface, Vapor particle partitioning, Vaporization, Adsorption, Desorption, Model studies.

Because of the high concentrations of PCBs in fish eaten by humans, it is important to understand the routes by which PCBs first enter the water and ultimately fish tissues. In order to evaluate these transport processes, it is instructive to study the environmental behavior of these compounds. The primary phenomenon noted here is the atmospheric removal of the particle-associated fraction. The overall input of PCBs to Lake Michigan was estimated to range from about 300 to 550 kg per year. These estimates were obtained by combining a series of models and data, obtained from published literature, which covered the major transport mechanisms. Estimates were made for inputs from vapor-particle partitioning, vapor washout, particle-associated washout, dry deposition of particle-associated PCBs, vapor phase transfer, bubble stripping and bubble bursting. (Halterman-PTT)
W86-02019

EVIDENCE FOR THE ATMOSPHERIC FLUX OF POLYCHLORINATED BIPHENYLS TO LAKE SUPERIOR,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
S. J. Eisenreich, and B. B. Looney.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 141-156, 1 fig, 3 tab, 36 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Great Lakes, *Lake Superior, Air-water Partition coefficients, Air pollution, Transport, Water pollution, Model studies, Air-water interface.

Because of the magnitude of the PCB concentrations in marine, the Great Lakes, and urban atmospheres, atmospheric transport has been implicated as a primary input pathway to aquatic ecosystems. The calculation of PCB vapor flux across the air/water interface, which is critically important in quantifying atmospheric inputs, is described and quantified. Determinations were made by using reported air/water partition coefficients and comparing the results to a surface flux estimated from PCB and temperature profiles observed in Lake Superior, July 1978. The surface influx of PCB from the atmosphere was estimated as about 0.02 to 0.2 micrograms per square meter per day as compared to the gas-phase controlled influx calculated as about 0.17 micrograms per square meter per day. (Halterman-PTT)
W86-02020

ROLE OF SURFACE MICROLAYERS IN THE AIR-WATER EXCHANGE OF PCBS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. P. Rice, P. A. Meyers, and G. S. Brown.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 157-179, 4 fig, 5 tab, 31 ref. NA-79 RA-H-00001 NA-80 AA-D-00072.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Lake Michigan, *Air-water exchange, Surface microlayers, Air-water interface, Great Lakes, Aroclors, Suspended solids, Partition coefficients.

Recently, there is much interest in trying to explain the cycling of PCBs between the major environmental compartments, i.e., atmosphere, hydrosphere and lithosphere, and hence new compartments are being defined. One of these is the surface microlayer. Determinations of the concentrations of PCB in the microlayer and subsurface waters of Lake Michigan are presented. Results of these studies indicate that the portion of PCBs associated with the particulate phase is related to their cycling at this interface. Surface samples for the study were collected from throughout Lake Michigan during 1979 and 1980 with screen and plate samplers. Subsurface samples were collected from a 1 m depth. Data on concentrations of PCBs, suspended particulates, and partition coefficients for the surface microlayer and the subsurface waters are presented. (Halterman-PTT)
W86-02021

PCB DYNAMICS IN LAKE SUPERIOR WATER,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
S. J. Eisenreich, P. D. Capel, and B. B. Looney.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 181-211, 8 fig, 4 tab, 46 ref. R805172-01. R806084-01.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Lake Superior, Great Lakes, Water pollution, Sediment-water interfaces, Suspended solids, Aroclors, Adsorption.

PCBs are refractory compounds resisting chemical and biological degradation and are predicted to remain active for decades to come. Consequently, it is important to determine the dynamics of these compounds in aquatic ecosystems. A summary is presented of the findings regarding PCBs in the waters of Lake Superior during 1978 to 1980. Samples were taken from subsurface and surface waters, extracted, and analyzed by gas chromatography. Data on variations in concentrations of PCBs in various regions of Lake Superior, as well as in-depth profiles, are presented. (Halterman-PTT)
W86-02022

ROLE OF THE BENTHIC BOUNDARY IN THE CYCLING OF PCBS IN THE GREAT LAKES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
B. J. Eadie, C. P. Rice, and W. A. Frez.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 213-228, 5 fig, 2 tab, 24 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Sediment-water interface, Great Lakes, Lake Michigan, Suspended solids, Sedimentation, Water pollution, Transport, Partition coefficients, Air pollution.

Transport processes within the benthic boundary layer (BBL) are important in determining the residence times of compounds, such as PCBs, in the Great Lakes. A review of the available information on this topic is presented, as well as the results of studies on recent sediment accumulation, resuspension, and transport of PCBs within the BBL. Data from analyses of water column and sediment trap samples indicate that approximately 14% of the current water column inventory of particle-associated PCB can be accounted for by winter resuspension. Reentrainment of pore water-associated PCB is small, but may be significant if associated with soluble natural organics or colloidal material. The net effect of resuspension is to increase the residence time for contaminants in active ecosystems. (Halterman-PTT)
W86-02023

PCB ACCUMULATION IN SOUTHERN LAKE MICHIGAN SEDIMENTS: EVALUATION FROM CORE ANALYSIS,
Wisconsin Univ.-Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 5A.
W86-02024

PCBS IN SEDIMENT AND FLUVIAL SUSPENDED SOLIDS IN THE GREAT LAKES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
R. L. Thomas, and R. Frank.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 245-267, 3 fig, 7 tab, 28 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Great Lakes, Sediments, Water pollution, Suspended solids, Lake Superior, Lake Michigan, Lake Erie, Lake Huron, Lake Ontario, Lake St. Clair.

PCBs are ubiquitous in the Great Lakes water column, sediment and fish. However, the extent of their distribution is thought to be best demonstrated in bottom sediment and sediment introduced by rivers and lake drainage. Levels of PCBs observed within the Lakes reflect point and diffuse sources from industrial regions (high levels) within the basin as well as widely dispersed origins from the atmosphere (low levels). This program entailed sampling a grid pattern of 216 stations in Lake Ontario in 1968; 176 stations in Lake Huron in 1969; 55 stations in Lake St. Clair in 1970 and 1974; 259 stations in Lake Erie in 1971; 214 stations in the Bay of Quinte in 1972-1973; 405 stations in Lake Superior, 115 stations in Georgian Bay and 55 stations in North Channel in 1973; and 279 stations in Lake Michigan in 1975. (Halterman-PTT)
W86-02025

ESTIMATING BIOCONCENTRATION POTENTIAL FROM OCTANOL/WATER PARTITION COEFFICIENTS,

Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W86-02026

STEADY STATE MODELING OF TOXIC CHEMICALS-THEORY AND APPLICATION TO PCBS IN THE GREAT LAKES AND SAGINAW BAY,
Manhattan Coll., Bronx, NY.
R. V. Thomann, and J. A. Mueller.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 283-309, 11 fig, 4 tab, 14 ref. CR 07853-01.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Great Lakes, Saginaw Bay, Model studies, Suspended solids, Water pollution, Toxicity transport, Volatility.

Understanding the fate of a chemical such as PCB in a natural water system one must recognize the dynamic relationship between atmospheres, water column andd sediments. However, there are several advantages to using steady state calculations. The authors developed a simplified steady state model that provides increased understanding of the processes that are operative and permits unambiguous estimations of model parameters. The mechanisms that result from the derivation of the model are presented, with specific reference to PCBs. The application of the model to Saginaw Bay and the Great Lakes as a whole is presented. Predictions of PCB loadings, volatilization, PCB concentrations, fluxes to sediments, and fluxes to downstream are also made. (Halterman-PTT)
W86-02027

MODEL SIMULATION OF PCB DYNAMICS IN LAKE MICHIGAN,
De Paul Univ., Chicago, IL.
For primary bibliographic entry see Field 5A.
W86-02028

DYNAMIC MASS BALANCE OF PCB AND SUSPENDED SOLIDS IN SAGINAW BAY -- A CASE STUDY,
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
W. L. Richardson, V. A. Smith, and R. Wethington.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 329-366, 15 fig, 9 tab, 19 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Great lakes, *Saginaw Bay, Aroclors, Lake Huron, Model studies, Suspended solids, Water pollution, Air pollution, Transport, Volatility, Sedimentation, Mass balance.

A serious problem concerning PCBs in the Great Lakes area is how long PCB concentrations in fish will remain above the FDA action limit of 5 mg per kg. Many 'reservoirs', including landfills, roads sealed with PCB-oil mixtures, contaminated sediments and long-range atmospheric transport and deposition, still act as sources of contamination, In order to answer questions posed by regulators concerning the possible future status of PCBs, studies were conducted on data obtained in the Great Lakes region during 1979. Studies resulted in the development of a model for the dynamic mass balance of PCB and suspended solids in Saginaw Bay. The model was used to determine volatilization rates and to estimate the expected longevity of PCBs in the system. The model was constructed with 1979 data on PCB concentrations in the water column (total, dissolved, particulate), suspended solids, mass PCB on solids and distribution coefficients. The best comparison of model simulations to the measured concentrations was made with the distribution coefficients for A 1242, of about 60% of those for A 1260 and with a volatilization rate for Aroclor 1242 of 0.2 m per day. The volatilization rate for a 1260 was determined to be no more than 0.05 m per day. The calibrated volatilization rate for Aroclor 1242 compares well with the theoretical value, but that calibrated for Aroclor 1260 is much smaller than the theoretical value. Total PCB is calculated to decrease by 90% within 10 years. (Halterman-PTT)
W86-02029

MONITORING OF PCBS IN WATER, SEDIMENTS AND BIOTA OF THE GREAT LAKES - SOME RECENT EXAMPLES,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5A.
W86-02030

VOLATILIZATION OF PCB FROM SEDIMENT AND WATER: EXPERIMENTAL AND FIELD DATA,
New York State Dept. of Environmental Conservation, Albany.
T. J. Tofflemire, T. T. Shen, and E. H. Buckley.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 411-422, 1 fig, 42 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Volatility, Sediments, Control techniques, Vegetation, Water pollution, Air pollution, Transport, Air-water interface, Waste dumps.

As for a number of toxic chlorocarbons, the volatilization losses of PCB are substantial in spite of very low vapor pressures. Studies were conducted on PCB volatilization, air monitoring, and PCB levels in vegetation. Data indicate that volatilization of PCBs can be an important source of air pollution under certain environmental conditions. PCB concentrations are fairly high in ambient air and in vegetation near PCB dump sites. Air concentrations are 0.002 to 0.11 of the sediment concentrations. Extremely high levels of PCBs (up to 2800 ppm) were found in plants growing on PCB dumps, while levels of 0.1 or 0.2 ppm were observed in plants collected in areas removed from known sources. (Halterman-PTT)
W86-02031

APPLICATION OF A SEDIMENT DYNAMICS MODEL FOR ESTIMATION OF VERTICAL BURIAL RATES OF PCBS IN SOUTHERN LAKE MICHIGAN,
Environmental Research Lab.-Duluth, MN.
D. Weininger, D. E. Armstrong, and D. L. Swackhamer.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 423-439, 6 fig, 2 tab, 13 ref. 68-01-0502.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Sedimentation, *Lake Michigan, Sediments, Water pollution, Model studies, Great Lakes, Transport.

The rate of recovery of Lake Michigan from PCB contamination is affected by the release of PCBs from the sediments. Sedimentation acts as a burial process, rendering the PCB-laden surficial sediments as sinks. A sediment dynamics model is presented for use in estimating these vertical burial rates. An expected response of Lake Michigan sediments to burying surficial PCBs is 5 - 10 years. It appears that the surficial sediments over most of the southern basin have reached their maximum PCB concentration and are now decreasing in concentration. (Halterman-PTT)
W86-02032

ECOLOGICAL EFFECTS OF ACID PRECIPITATION,
Sigma Research, Inc., Richland, WA.
For primary bibliographic entry see Field 5C.
W86-02039

HAZARDOUS AND TOXIC WASTES: TECHNOLOGY, MANAGEMENT AND HEALTH EFFECTS,
The Pennsylvania Academy of Science, Easton, PA. 1984. Edited by S. K. Majumdar and E. W. Miller. 442 p.

Descriptors: *Fate of pollutants, *Water pollution sources, *Waste disposal, Water quality control, Landfills, Geology.

Selected papers from this volume concerning water resources include hazardous waste disposal by pozzolanic cementation, geological factors in disposal site selection, the time perspective in waste management, selection of suitable sites for constructing hazardous waste facilities, and the character, fate, and effects of coal tar wastes. (Cassar-PTT)
W86-02041

TIME PERSPECTIVE IN THE SUBSURFACE MANAGEMENT OF WASTE,
Pennsylvania State Univ., University Park.
R. R. Parizek.
IN: Hazardous and Toxic Wastes: Technology, Management and Health Effects, The Pennsylvania Academy of Science, Easton, PA. 1984. p 137-169, 8 fig, 8 tab, 24 ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Groundwater pollution, Organic compounds, Aquifers, Solute transport, Geohydrology, Geochemistry, Waste disposal, Rivers, Sediments, Lakes, Estuaries, Metals, Water quality.

Groundwater pollution from waste disposal sites may not be apparent in the short term. The time perspective is very important in waste management because many pollutant transport processes are not well understood on the scale of thousands of years. Of urgent concern are hydrologically active areas, land areas which contribute pollutants directly to ground and/or surface waters, even during minor precipitation events. Pollutants may enter drainage basins via the atmosphere, rivers and streams, groundwater, and erosion in lakes and estuaries. Each pathway has its own travel time, attenuation mechanisms, and control measure potential. The effects of toxic substances in lake sediments are exaggerated because of recycling and biomagnification. Wastes are characterized according to persistence and toxicity. Easily biodegradable substances are less likely to survive long-term transport in slowly moving systems, whereas highly persistent compounds and metals may pose hazards for many years. Conditions favoring contamination of groundwater are permeable surficial deposits, great differences in permeability between surface and bedrock layers, low relief terrain, drainage tiles, sinkholes, secondary openings in bedrock, shallow aquifers, and confined aquifers. (Cassar-PTT)
W86-02044

COAL TAR WASTES: THEIR ENVIRONMENTAL FATE AND EFFECTS,
Pennsylvania Power and Light Co., Allentown.
J. F. Villaume.
IN: Hazardous and Toxic Wastes: Technology, Management and Health Effects, The Pennsylvania Academy of Science, Easton, PA. 1984. p 362-375, 3 fig, 3 tab, 22 ref.

Descriptors: *Water pollution sources, *Fate of pollutants, Coal gasification, Coal tar, Metals, Cyanide, Organic compounds, Adsorption, Wastewater treatment.

Coal tar, a byproduct of coal gasification, is a complex mixture of free carbon and up to 10,000 organic compounds, principally polynuclear aromatic hydrocarbons. In the past much of this byproduct was disposed of in injection wells or lagoons. Several instances of drinking water well contamination by coal tar have been reported. The chief problems are taste and odor, heavy metals, and cyanide. Free coal tar readily moves through the unsaturated zone only where the water table is deep or where the tar is less dense than water. In the saturated zone coal tar denser than water moves in a separate liquid phase according to the distribution of capillary pressure forces. At Stroudsburg, Pa., 8000 gallons of nearly pure coal tar have been recovered in a depression in relatively impermeable silty sand. Phenolics and naphthalene levels increase more rapidly in groundwater than simple dilution can produce. Available reme-

dial actions include containment with a bentonite slurry wall, pumping of coal tar collected in pools, lime treatment mixture with a proprietary diluent, hydraulic isolation, and emulsification with in situ water flooding. However, these methods are costly and not always immediately and totally effective. (Cassar-PTT)
W86-02046

ESTUARY AS A FILTER,
For primary bibliographic entry see Field 2L.
W86-02070

ESTUARY AS A FILTER: AN INTRODUCTION,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 2L.
W86-02071

TURBULENCE AND MIXING IN ESTUARIES,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W86-02072

TRANSPORT VARIABILITY IN A FJORD,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2L.
W86-02074

ESTUARINE INTERACTION OF NUTRIENTS, ORGANICS, AND METALS: A CASE STUDY IN THE DELAWARE ESTUARY,
Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W86-02081

ANTHROPOGENIC NITROGEN LOADING AND ASSIMILATION CAPACITY OF THE HUDSON RIVER ESTUARINE SYSTEM, USA,
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 2L.
W86-02083

ENVIRONMENTAL CHARACTERIZATION OF CHESAPEAKE BAY AND A FRAMEWORK FOR ACTION,
Environmental Protection Agency, Annapolis, MD. Chesapeake Bay Program.
For primary bibliographic entry see Field 2L.
W86-02092

LOCATING THE GROUNDWATER POLLUTION SOURCES USING COMPUTER MODELS,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
J. D. Hwang, A. Ayubcha, J. S. Chich, and S. Richardson.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 534-547, 9 fig. 4 tab, 5 ref.

Descriptors: *Groundwater pollution, *Water pollution sources, *Computer models, *Numerical analysis, *Solute transport, Test wells, Organic solvents, Fate of pollutants, Model studies, Monitoring.

Two different computer numerical approaches were used to locate groundwater pollution sources at the Emmaus site, Little Creek Valley, Pennsylvania: nonsequential and sequential optimization. Results for detecting trichloroethylene (TCE) pollution sources in test wells are presented. TCE in this site study is assumed to be a dissolved pollutant dispersed in and convected by the groundwater. The actual point source was later determined to be about 100 ft from the node showing the highest pollutant concentrations. The models were applied to solute transport studies for TCE at the Curtiss Well Pollution Site in Southington, Connecticut. Initial investigations indicated that the groundwater pollution at the well may have started as early as 1955. The results clearly demonstrate that there is an area-source in the northwest side of Quinnipac River and a point source south-southwest to one of the production wells. The computer prediction of area source location agrees quite well with the actual field investigation results. This technique holds the promise of being able to determine where additional wells should be located for on-going pollution monitoring. (Geiger-PTT)
W86-02121

WATER CHLORINATION: ENVIRONMENTAL IMPACT AND HEALTH EFFECTS; VOLUME 4, BOOK 1: CHEMISTRY AND WATER TREATMENT,
For primary bibliographic entry see Field 5F.
W86-02135

SUMMARY OF STUDIES ON MODELING PERSISTENCE OF DOMESTIC WASTEWATER CHLORINE IN COLORADO FRONT RANGE RIVERS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
T. J. Heinemann, G. F. Lee, R. A. Jones, and B. W. Newbry.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 97-112, 4 fig, 2 tab, 12 ref.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Chlorination, *Chloramines, Model studies, Colorado Front Range, Effluents, Kinetics.

A modeling approach has been developed based on several Colorado Front Range streams in the vicinity of chlorinated wastewater treatment plant effluent discharges to estimate the persistence of chloramines in natural water systems. It was found through a series of simple measurements and tests that rate constants can be developed to describe the dissipation rate of chlorine and its dilution so that estimates can be made of the persistence of the chlorine downstream of the wastewater treatment plant discharges. This approach reliably predicts chlorine persistence in most sites evaluated and has been verified to a limited extent in Colorado Front Range streams. (Author)
W86-02141

NATURAL DECHLORINATION KINETICS OF SECONDARY MUNICIPAL EFFLUENTS,
Beak Consultants Ltd., Mississauga (Ontario).
For primary bibliographic entry see Field 5D.
W86-02142

EFFECT OF BROMIDE AND NITRITE ON THE DEGRADATION OF MONOCHLORAMINE,
California Univ., Berkeley. Lawrence Berkeley Lab.
R. L. Valentine, and R. E. Selleck.
IN: Water Chlorination: Environmental Impact and Health Effects: Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 125-137, 7 fig. 2 tab, 14 ref. W-7405-eng-48.

Descriptors: *Fate of pollutants, *Chlorination, *Chloramines, Nitrites, Bromides, Monochloramine, Chemical degradation, Catalysts, Kinetics, Oxidation.

The effect of nitrite on monochloramine disappearance in the presence of bromide was evaluated by measuring total oxidant concentration with time using monochloramine with nitrite, with bromide, and with nitrite and bromide. Nitrite in the presence of bromide greatly accelerated the rate of oxidant decay, which was independent of the initial monochloramine concentration. The nitrite was not significantly consumed in a 1:1 stoichiometric oxidation by monochloramine. If the effect of nitrite is catalytic, it may also accelerate other oxidation-reduction reactions. If not, a complex-oxidation reduction, possibly involving bromide as a catalyst, is indicated. (Cassar-PTT)
W86-02143

CHEMISTRY OF COMBINED RESIDUAL CHLORINATION,
California Univ., Berkeley. Div. of Sanitary, Environmental, Coastal, and Hydraulic Engineering.
S. F. Leao, and R. E. Selleck.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983, p 139-149, 6 fig, 10 ref. W-7405-eng-48.

Descriptors: *Fate of pollutants, *Chlorination, *Chloramines, Chlorine residual, Kinetics, Ammonia, Chemical degradation.

The decomposition of monochloramine and dichloramine was observed at pH 6.6. Monochloramine decayed continuously (described as second-order at low concentrations), reaching a rather flat peak at about 120 hours. Dichloramine concentrations increased slightly up to about 10 hours, then continuously decreased. The overall second-order rate decreased with larger ammonia concentrations. The concentration of dichloramine was more or less independent of ammonia concentration. This shows that, in the absence of free chlorine, the concentration of ammonia does not appear to affect the rate of disappearance of the residual other than through the formation of NHC12 by NH2C1 hydrolysis. The reaction between NHC12 and ammonium ion to form NH2C1 is either much slower than reported or has a rate-limiting step not involving ammonia or ammonium ion. (Cassar-PTT)
W86-02144

PRODUCT DISTRIBUTION AND RELATIVE RATES OF REACTION OF AQUEOUS CHLORINE AND CHLORINE DIOXIDE WITH POLYNUCLEAR AROMATIC HYDROCARBONS,
Minnesota Univ.-Duluth. Dept. of Chemistry.
R. J. Liukkonen, S. Lin, A. R. Oyler, M. T. Lukasewycz, and D. A. Cox.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 151-165, 3 tab, 41 ref. EPA R807455.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Aromatic hydrocarbons, Chlorine, Chlorine dioxide, Polynuclear aromatic hydrocarbons, Organic compounds, Oxidation, Kinetics.

Substituting chlorine dioxide for chlorine in water treatment was studied by treating aqueous solutions of polynuclear aromatic hydrocarbons (PAHs) with either compound. Two major considerations were indicated. (1) The reaction rates of chlorine dioxide with PAHs in water were slower than those of chlorine. Chlorine dioxide reactions paralleled the half-wave potential of the PAHs. (2) The products formed by reaction of the PAHs with chlorine and chlorine dioxide were generally similar (phenols, quinones, chloro derivatives) with structural variations dependent on the particular reactive species such as molecular chlorine, hypochlorous acid, hypochlorite, or hlorine dioxide). A table lists about 20 PAHs and their reaction times, and depicts the structures of the reaction products. (Cassar-PTT)
W86-02145

REACTIONS OF CHLORINE AND CHLORINE DIOXIDE WITH FREE FATTY ACIDS, FATTY ACID ESTERS, AND TRIGLYCERIDES,
Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
H. A. Ghanbari, W. B. Wheeler, and J. R. Kirk.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 167-177, 1 fig, 3 tab, 10 ref. PFR 78-27067.

Descriptors: *Fate of pollutants, *Chlorination, *Lipids, *Fatty acids, *Organic compounds, Chlorine, Chlorine dioxide, Triglycerides.

The following lipids were chlorinated with hypochlorous acid and chlorine dioxide: oleic acid, methyl oleate, linoleic acid, methyl linoleate, linolenic acid, methyl linolenate, arachidonic acid, methyl arachidonate, triolein, olive oil triglycerides, and wheat germ triglycerides. Rate constants were determined. The free fatty acids were more reactive toward the chlorinating agents than their corresponding esters. For example, the rate constant for hypochlorous acid reacting with oleic acid was -11.44 per min; foor methyl oleate, -76.13 per min. Reaction with labeled chlorinating agents showed that fatty acids incorporated more chlorine than the corresponding esters. Oleic acid reacted with hypochlorous acid for 60 min incorporated 10.4% of the chlorine; methyl oleate, 1.67%. The major product of oleic acid and hypochlorous acid was identified as 9-chloro, 10-hydroxyl methyl stearate. (Cassar-PTT)
W86-02146

CHLORINATION PRODUCTS FROM AQUATIC HUMIC MATERIAL AT NEUTRAL PH,
North Carolina Univ. at Chapel Hill. School of Public Health.
D. L. Norwood, J. D. Johnson, R. F. Christman, and D. S. Millington.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 191-200, 3 fig, 1 tab, 14 ref. CR 806679.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Humic acids, *Fulvic acids, *Organic matter, Chlorine demand, Organic compounds, Aromatic compounds.

Products of the aqueous chlorination of a natural humic material at pH 7 were identified with a double-focusing, magnetic mass spectrometer capable of fast scan rates. Three common features were noticeable. (1) All compounds were methyl esters with the exception of chloroform and chloral. (2) Most compounds contained chlorine. Examples are methyl mono-, di-, and trichloroacetate, methyl-2,2-dichloropropionate, dimethylmonochlorosuccinate, dimethylmonochloromaleate, dimethyldichloromalonate, dimethyldichlorossucinate, and dimethyldichloramaleate. (3) Most non-chlorine-containing compounds were aromatic. Examples are dimethylphthalate and isomers, benzene tricarboxylic acid trimethyl ester, and benzene tetracarboxylic acid tetramethyl ester. Both fulvic acid and humic acid fractions produced extremely similar products. However, the fulvic chlorination sample contained 60% more organically bound chlorine than the humic sample, even though the reaction time of the humic sample was twice as long. (Cassar-PTT)
W86-02148

FULVIC ACID AND CHLORINATED FULVIC ACID IN WATER AND SEDIMENT: HPLC FRACTIONATION AND SPECTROSCOPIC CHARACTERIZATION,
North Texas State Univ., Denton. Inst. of Applied Sciences.
F. Y. Saleh, and M. Mokti.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 201-217, 8 fig, 3 tab, 14 ref. R-8058-22.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Fulvic acids, *Organic matter, Chlorine demand, Trihalomethanes, Organic compounds, Liquid chromatography, Lakes, Sediments.

Fulvic acid, obtained from water and sediment from three reservoirs in Texas, Oklahoma, and Louisiana, and chlorinated fulvic acid were fractionated and characterized by high performance liquid chromatography using C-108 column, weak anion exchange and reverse-phase. The fulvic acids from different sources had common characteristic components. The pH profile of the carrier solvents and the extent of protonation of the fulvic acid macromolecule controlled the fractionation. The higher the apparent molecular weight of the fulvic acid, the less its potential for trihalomethane formation. (Cassar-PTT)
W86-02149

ORGANIC REACTION PRODUCTS OF CHLORINE DIOXIDE AND NATURAL AQUATIC FULVIC ACIDS,
North Carolina Univ. at Chapel Hill. School of Public Health.
C. A. Colclough, J. D. Johnson, R. F. Christman, and D. S. Millington.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 219-229, 3 fig, 2 tab, 9 ref. R804430.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Fulvic acids, *Chlorine dioxide, Chlorine demand, Organic matter.

The oxidation of aquatic humic materials by chlorine dioxide was conducted at ph 7.8 to simulate natural surface water conditions and at pH 3 to take advantage of the full oxidizing activity of chlorine dioxide. About 70% of the original total organic carbon was recovered after the reaction; about 30% was lost as carbon dioxide or other volatile compounds. Products isolated represented only a small fraction of the initial fulvic material, much of which did not degrade sufficiently for analysis by the techniques used. Products produced at pH 7.8 and at pH 3 did not differ significantly. Of the identified compounds, most were methyl esters of the following classes: benzenepolycarboxylic acid methyl esters, aliphatic dibasic acid dimethyl esters, carboxyphenylglyoxylic acid methyl esters, and aliphatic acid monomethyl esters. Benzene di- and tricarboxylic acid methyl esters and palmitic esters and their isomers were found in abundance in both the undegraded control and the chlorinated product mixture. Also identified were methylated aromatic derivatives of glyoxylic acid, furan and dioxane derivatives, monochloromalonic acid dimethyl ester, monochlorosuccinic acid dimethyl ester, and dichloroacetic acid methyl ester. Results indicate that, at neutral pH, only limited reaction occurs between chlorine dioxide and aquatic fulvic acid. (Cassar-PTT)
W86-02150

INFLUENCE OF AQUATIC HUMIC SUBSTANCE PROPERTIES ON TRIHALOMETHANE POTENTIAL,
Canada Centre for Inland Waters, Burlington (Ontario).
B. G. Oliver, and E. M. Thurman.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 231-241, 3 fig, 2 tab, 26 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Humic acids, Organic matter, Chlorine demand, Color, Trihalomethanes, Chlorinated hydrocarbons, Fulvic acids, Phenols.

There are site variations in trihalomethane (THM) potential for humic materials from diverse climatic and geologic environments. Groundwater humics had the lowest THM potentials, marsh-bog humics had the highest THM potentials, and surface water humics had intermediate THM potentials. Trends of higher THM potential with higher phenolic content and larger molecular size were observed, but the best correlation was between THM potential and color. Color was used to predict the THM potential of various natural waters. (Author)
W86-02151

EMPIRICAL MODEL FOR PREDICTING CHLOROFORM FORMATION FROM HUMIC AND FULVIC ACIDS,
B. A. Engerholm, and G. L. Amy.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 243-252, 3 fig, 2 tab, 16 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Organic matter, Humic acids, Fulvic acids, Chlorine demand, Model studies, Trihalomethanes, Chloroform, Chlorinated hydrocarbons.

A multiparameter equation was developed for predicting chloroform formation from humic substances in water. The basic equation for humic acid encompasses the reaction time, temperature, pH, and the initial total organic carbon and chlorine/total organic carbon ratio. Also presented is a generalized equation, containing precursor-related constants, for predicting the chloroform concentration derived from fulvic acid or other precursors. Application of this equation is limited to situations in which a free chlorine residual is present and requires caution for reaction times of less than 1 hour or greater than 96 hours. (Author)
W86-02152

FORMATION OF TRIHALOMETHANES FROM THE HALOGENATION OF 1,3-DIHYDROXYBENZENES IN DILUTE AQUEOUS SOLUTION: SYNTHESIS OF 2-13 C-RESORCINOL AND ITS REACTION WITH CHLORINE AND BROMINE,
California Inst. of Tech., Pasadena. Dept. of Environmental Engineering Science.
S. D. Boyce, A. C. Barefoot, D. R. Britton, and J. F. Horning.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1; Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 253-267, 6 fig, 2 tab, 20 ref. C3049NAET.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Organic matter, Resorcinol, Dihydroxybenzenes, Aromatic compounds, Trihalomethanes, Chloroform, Bromoform, Chlorine demand, Bromination, Chemical reactions.

Halogenation of labeled resorcinol (1,3-dihydroxybenzene) produced labeled chloroform, labeled bromoform, and other products. This indicates that trihalomethane formation occurs via electrophilic halogenation and subsequent bond clevage at the C2 site of the aromatic ring. Five generalizations were made from this study. (1) In acidic, neutral, or alkaline solution 1,3-dihydroxyaromatic substrates react with chlorine and bromine to produce higher yields of chloroform and bromoform than do the corresponding 1,2- and 1,4-dihydroxy isomers. (2) Maximum yields of trihalomethanes from 1,2-dihydroxyaromatic compounds occur between pH 8 and 10. (3) Bromination of acetone, 2-butanone, and 2-pentanone shows pH dependence of bromoform yields. Chlorination of these compounds does not produce significant chloroform. (4) All bromination reactions produce equivalent yields of bromoform as measured by direct injection analysis. Chlorination reactions produce higher yields for each substrate at low pH. This difference may have been the result of formation of labile chloroform-substituted intermediates in acidic solution which decomposed to chloroform during analysis. (5) Each 1,3-dihydroxyaromatic substrate shows a maximum chloroform or bromoform yield at a reactant ratio (halogen/substrate) of 7, except for 1,3-dihydroxynaphthalene (Maximum at 5:1). (Cassar-PTT)
W86-02153

KINETICS AND MECHANISM OF HALOFORM FORMATION: CHLOROFORM FORMATION FROM TRICHLOROACETONE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
M. D. Gurol, A. Wowk, S. Myers, and I. H. Suffet.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 269-284, 9 fig, 3 tab, 16 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, Chlorine demand, Chloroform, Trichloroacetone, Organic compounds, Chlorinated hydrocarbons, Chemical reactions, Hydrolysis.

The kinetics and mechanism of trichloroacetone (TCA) degradation was studied to determine

whether any chloroform is formed by this pathway. TCA at concentrations of 7 to 40 mg/liter was reacted at 25 degrees C at pH of 6 to 8 in the presence of 0 to 75 mg/liter chlorine. Hydrolysis and chlorination of TCA occurred simultaneously in chlorinated water. The total rate of chloroform formation by these two reaction pathways is too slow to account for the chloroform concentrations observed under typical conditions of water treatment. For example, at pH 7 and with free available chlorine of 10 mg/liter, only 10% of TCA degrades into chloroform during a contact time of 60 min. This corresponds to the formation of about 0.07 micrograms/liter of chloroform if the steady-state concentration of TCA in water is 1 microgram/liter. An additional 3 microgram/liter of chloroform is expected to form in the distribution system after 5 days in the presence of 2 mg/liter free available chlorine. A reaction that causes further halogenation of the chlorinated intermediate with eventual degradation to chloroform occurs simultaneously with hydrolysis of the chlorinated intermediate to chloroform, as opposed to the haloform reaction. The reaction between TCA and chlorine is faster than the hydrolysis reaction for chlorine concentrations above 1.5 mg/liter and at neutral pH. (Cassar-PTT)
W86-02154

QUANTITATIVE EFFECTS OF BROMINE ON THE FORMATION AND DISTRIBUTION OF TRIHALOMETHANES IN GROUNDWATER WITH A HIGH ORGANIC CONTENT,
Florida International Univ., Miami. Drinking Water Quality Research Center.
W. J. Cooper, L. M. Meyer, C. C. Bofill, and E. Cordal.
IN: Water Chlorination: Environmental Impact and Helath Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 285-296, 8 fig, 1 tab, 15 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, Chlorine demand, Bromides, Chlorinated hydrocarbons, Trihalomethanes, Organic matter.

The effect of bromide on trihalomethane (THM) formation was studied at four levels of added bromide ().008, 0.08, 0.8, and 8.0 mg/liter) and four levels of added chlorine (8.35, 16.7, 25.1, and 33.4 mg/liter). Water used in the experiments was lower Florida peninsula groundwater with 6 mg/liter total organic carbon and 50 units of color. The presence of bromide significantly affected the formation and distribution of THMs. The chloroform concentration differed only slightly between the natural groundwater and bromide-augmented groundwater at the lower two bromide levels (at all levels of added chlorine) indicating that a minimum bromide concentration is necessary to influence chloroform formation. However, at the higher bromide concentrations chloroform concentration decreased significantly. The effect of bromide on CHC12Br formation was also minimal at the two lowest bromides levels. At 0.8 mg/liter bromide the CHC12Br level increased; at 8.0 mg/liter bromide, its formation was retarded. Formation of CHC1Br2 and bromoform increased with added bromide, but the relationships were not linear. The total concentration of THMs formed was not influenced greatly by bromide addition. (Cassar-PTT)
W86-02155

FORMATION OF BROMINATED TRIHALOMETHANES: EXTENT AND KINETICS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
J. P. Gould, L. E. Fitchhorn, and E. Urheim.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 297-310, 7 fig, 2 tab, 8 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, Bromination, Trihalomethanes, 2,46-Trihydroxyacetopheonone, Organic compounds, Chlorine demand, Kinetics, Chemical reactions, Model studies.

A bromine incorporation factor was used to examine trends in the extent and rate of formation of brominated trihalomethanes (THMs). This factor represents bromination as a single quantitative measure, greatly simplifying the interpretation of data on the concentrations of the four THMs (CHC13, CHC12Br, CHC1Br2, and CHBr3). Phloroacetophenone (2,4,6-trihydroxyacetophenone) was selected as the model precursor. The degree of bromine incorporation was dependent on the initial characteristics of the reaction system (pH, bromide concentration, HOC1 concentration, precursor concentration) but largely independent of time. An extension of an empirical model developed by Kavanaugh for chloroform was also used to study the kinetics of individual THM formation. On the basis of this mode, bromination kinetics were substantially faster than chlorination kinetics. These studies show that a conclusive model for THM formation kinetics cannot be developed until the complete mechanism of THM formation has been fully explained. (Cassar-PTT)
W86-02156

BROMOFORM PRODUCTION IN TROPICAL OPEN-OCEAN WATERS: OCEAN THERMAL ENERGY CONVERSION CHLORINATION,
California Univ., Berkeley. Lawrence Berkeley Lab.
E. O. Hartwig, and R. Valentine.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 311-330, 6 fig, 7 tab, 22 ref. W-7405-eng-48.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, Bromoform, Trihaomethanes, Chlorine demand, Organic matter, Ocean Thermal Energy Conversion process, Hawaii, Cooling water, Evaportation discharge, Condensers, Seawater.

Formation of bromoform and other volatile organics during chlorination of evaporator and condenser seawater used for the Ocean Thermal Energy Conversion process is reported. Bromoform was the major halogenated organic compound produced as a result of chlorinating seawater at chlorine doses less than 1 mg/liter. Significantly greater quantities of bromoform were produced in evaporator water than in the condenser water as a function of total residual oxidant in both chlorinated and dechlorinated (with sodium thiosulfate) stored samples. No immediate bromoform production was detected in the dechlorinated condenser water, but 1-2 micrograms/liter was immediately produced in dechlorinated evaporator water. The difference in bromoform concentrations of dechlorinated evaporator and condenser water was related to water quality. Mean values for pH and total organic carbon (micrograms/liter) for evaporator water were 8.27 and 1.17; for condenser water, 7.64 and 0.758. Evaporator water temperature was about 25 degrees C; condenser water 5.6 degrees C. Daily potential bromoform production by this plant with a mixed discharge of 34.9 million liters/hour, 0.2 mg total residual oxidant/liter, and 2 hours of chlorination per day equals 1.3 billion micrograms. Considering a 20-fold dilution within 2 hours, the bromoform concentration of the discharge water would be 0.93 micrograms/liter. (Cassar-PTT)
W86-02157

DISPERSION OF CHLORINE AT SEVEN SOUTHERN CALIFORNIA COASTAL GENERATING STATIONS,
Southern California Edison Co., Rosemead.
R. S. Grove.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 333-346, 5 fig, 3 tab, 6 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Cooling water, Powerplants, Southern California Edison Company, Seawater.

The fate of chlorine in powerplant cooling systems and the dispersion of chlorine in receiving waters were monitored at seven coastal generating stations of the Southern California Edison Company. Remarkable variability was observed in chlorine injection concentrations, condenser outlet concentrations, outfall concentrations, and dissipation rates among the generating stations. Less variability was seen within surveys done at the same generating station. No patterns of chlorination could be discerned among the data except for one station with a rigorous chlorine control program. Chlorine levels were below the detectable limit of 0.08 mg/liter at over half of the plant outfalls. The surveys also showed that a much higher level of coordinated chlorine assessment work is necessary to fully characterize factors controlling chlorine release to the environment. These factors, which are site-specific, include (1) seasonal varability in water chlorine demand and slime growth in condenser tubes, (2) chlorine demand of piping and conduits beyond the condensers, (3) influence of macrofouling control heat treatment methods on chlorine demand, and (4) scouring effect of silty water on condenser tubes. (Cassar-PTT)
W86-02158

MODEL FOR PREDICTING CHLORINE CONCENTRATION WITHIN MARINE COOLING CIRCUITS AND ITS DISSIPATION AT OUTFALLS,
Central Electricity Generating Board, Fawley (England). Marine Biological Unit.
M. H. Davis, and J. Coughlan.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 347-257, 5 fig, 1 tab, 18 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Cooling water, Chlorine demand, Model studies, Seawwater, Powerplants.

A model for predicting the behavior of chlorine in powerplant cooling systems using seawater differs from previous models in two ways: (1) it supposes an exponential, rather than a hyperbolic decay and (2) it accomodates discrete rate constants for the discharged and receiving waters. Temperatures decrease only slightly in discharge canals, allowing a high decay rate. Dilution is responsible for the most significant decreases in temperature and chlorine concentration. Simulations show that the chlorine loss curve generated by serial dilutions is steeper than the theoretical dilution curve, even when allowance is made for continuing decay. This is partially explained by the additional chlorine demand introduced with the diluting water. Instantaneous chlorine demand is higher at open-coast sites than at estuarine sites. The decay curve of chlorinated samples, from open-coast sites, regenerates a breakpoint curve which is out of phase with the original. The decay of estuarine samples does not regenerate a pronounced breakpoint. (Cassar-PTT)
W86-02159

WATER CHLORINATION PROGRAMS AT ONTARIO HYDRO FOSSIL-FIRED GENERATING STATIONS,
Ontario Hydro, Toronto.
F. Butler, R. Kozopas, G. T. Haymes, and J. S. Griffiths.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 359-372, 6 fig, 3 tab, 4 ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Chlorination, *Fish, *Cooling water, Rainbow smelt, Smelt, Fish eggs, Eggs, Larvae, Lambton Generating Station, Lakeview Generating Station, R.L. Hearn Generating Station, Powerplants, Toxicity.

A chlorination regimen for controlling biofouling has been developed for Ontario Hydro's Lambton Thermal Generating Station. Normal maintenance chlorine dose is 0.19 kg/min for 20 min, twice a week. To combat excessive biofouling, shock chlorination in stages up to 900 kg/day for 30 min is used. During chlorination, adult fish (white bass and suckers) show an avoidance response at chlo-

rine concentrations below reported lethal concentrations. This response involves increased activity toward areas of reduced chlorine concentraion. Chlorine plume studies at three coal-fired stations outline the limited use zones for each area. In all cases no chlorine is detected at a depth greater than 3 m outside the influence of the jet stream from the outfall channel. During the chlorine studies a three-electrode continuous, on-line, automatic chlorine analyzer was developed. In a study of the effects of shock chlorination on fish eggs and fry, chlorine concentrations below 0.1 mg/liter (the maximum expected in discharges) have little effect on rainbow smelt eggs or larvae. Survival rates dropped raipdly as the temperature rises to 20 degrees C. (Cassar-PTT)
W86-02160

HALOGENATED ORGANIC STUDY AT SELECTED TENNESSEE VALLEY AUTHORITY FOSSIL-FUELED POWER PLANTS,
Tennessee Valley Authority, Chattanooga.
C. V. Seaman, L. O. Hill, B. W. Vignon, T. B. Stanford, and M. D. Hunter.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 373-382, 4 fig, 3 tab, 6 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, Organic compounds, *Cooling water, Trihalomethanes, Chloroform, Organic compounds, Tennessee Valley Authority, Powerplants.

Water samples were collected for organic analysis at the intake, outlet, and several points throughout the cooling systems of three Tennessee Valley Authority fossil-fueled steam plants. Chloroform was detected at each plant more than 90% of the time. Highest concentration detected was 18.0 mg/liter. Other volatile halogenated organics detected were bromodichloromethane, dibromochloromethane, 1,2-dichloroethane, trans-1,2-dichloroethylen, methylene chloride, and 1,1,1-trichloroethane. Semivolatile halogenated organics detected were 1-chloronaphthalene, 2-chlorophenol, and 1,2-dichlorobenzene. Comparison of inlet and outlet samples showed that outlet chloroform concentrations had a positive linear relationship with chlorine dose and a negative relationship with nitrogen species. The substrate was correlated significantly with chloroform concentration only when the effects of chlorine dosage were removed. Temperature was not apparently correlated with chloroform levels. However, combining the data across plants for the outlet location and removing the effects of other precursors showed a significant relationship. This suggested that temperature influences on chloroform concentrations were masked by effects of other variables. Likewise, the effects of chlorine demand and cooling water flow rate on chloroform production are masked. (Cassar-PTT)
W86-02161

ORGANOHALOGENS IN CHLORINATED COOLING WATERS DISCHARGED FROM NUCLEAR POWER STATIONS,
Battelle Pacific Northwest Labs., Richland, WA.
R. M. Bean, D. C. Mann, and D. A. Neitzel.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 383-390, 4 tab, 8 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Cooling water, Powerplants, Trihalomethanes, Phenols, Organic compounds, Chlorinated hydrocarbons, Aromatic compounds, Nuclear powerplants.

Formation of organhalogens, particularly phenolic compounds, during biocide treatment of cooling water was studied at three nuclear powerplants. Chloroform concentrations in the discharges were 0.5 to 1.1 micrgrograms/liter; CHBrC12, 0.7-1.0 micrograms/liter; CHBr2C1, 0.3-0.9 micrograms/liter; and bromoform, 0.1-3.7 micrograms/liter. Concentrations of major phenolic compounds (in micrograms/liter) in chlorinated cooling waters were 2,4,6-trichlorophenol, 0.7; bromodichlorophenol, 0.5; dibromochlorophenol, 0.3; 2,4,6-tribromophenol, 0.4; and dibromodichlorophenol, 0.1. The highest total level of halogenated phenolic compounds at any station was 1.4 micrograms / liter. Conditions favoring the concentrations, longer chlorine residence time, higher bromine concentrations in intake water, low volatility, and presence of the biocide, which prevents biodegradation. In contrast, trihalomethanes tend to be released to the atmosphere in cooling towers. In once-through systems trihalomethanes were predominant.
W86-02162

ATMOSPHERIC EMISSIONS FROM ELECTRIC POWER PLANT COOLING SYSTEMS,
SRI International, Menlo Park, CA.
J. H. Smith, J. C. Harper, and B. C. DaRos.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 391-404, 8 fig, 3 tab, 6 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Cooling water, Organic compounds, Trihalomethanes, Powerplants, Air pollution, Chlorinated hydrocarbons.

Concentrations of volatile halogentated compounds were determined in recirculation water systems and in the tower drift of three powerplants. Maximum concentrations (micrograms/liter) observed in up to 8 separate tests during chlorination of recirculation water were as follows: chloroform, 14.5; bromodichloromethane, 3.1; chlorodibromomethane, 3.3; bromoform, 2.9; trichloroethylene, 1.1; tetrachloroethylene, 0.1; and chloramines, 1.6. In general, chloroform concentrations in the tower basin were 20-30% lower than concentrations in the tower riser, suggesting that the towers strip some of the volatiles during one pass through the tower. Concentrations of volatiles (micrograms/liter) in the tower drift, using several different methods, were chloroform, 0.0002-0.81; trichloroethylene, trace to 0.48; tetrachloroethylene, trace to 1.73; p-dichlorobenzene, 0.07-0.27; and p-chlorotoluene, 0.42-1.45. The sampling techniques for the drift were not considered efficient. (Cassar-PTT)
W86-02163

HYDROGEN PEROXIDE - A REAL ALTERNATIVE TO CHLORINE IN WATER TREATMENT,
North Surrey Water Co., Staines (England).
E. R. Gardiner, N. J. Hobbs, and J. Jeffery.
IN: Water Chlorination: Environmental Impact and Health Effect; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 405-419, 8 fig, 5 tab, 16 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Disinfection, *Hydrogen peroxide, Oxidation, Thames River, Trihalomethanes, Organic compounds, Chlorinated hydrocarbons.

Hydrogen peroxide and a low prechlorine dose reduce the trihalomethane (THM) formation at the prechlorination stage, but high postchlorination still yields high THM values. Hydrogen peroxide cannot be a complete replacement for prechlorination because it would not always achieve complete disinfection and would be difficult to monitor. Hydrogen peroxide with a low prechlorine dose achieves lower plate counts at 22 and 37 degrees C than chlorine alone. In the absence of free chlorine there is a lower value for THM formation in the presence of hydrogen peroxide. The coagulation treatment achieves an appreciable reduction in the potential THM formation. This work was carried out on actual river water samples that were variable. (Author)
W86-02164

BROAD-SPECTRUM ANALYSIS OF THE REMOVAL OF TRACE ORGANICS IN AN OZONE-GRANULAR ACTIVATED CARBON POTABLE-WATER PILOT PLANT STUDY,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
G. T. Coyle, S. W. Maloney, J. Gibs, and I. H. Suffet.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1981. p 421-443, 11 fig, 3 tab, 19 ref. CR806256-02.

Descriptors: *Fate of pollutants, *Pollutant identification, *Activated carbon, *Ozonation, Disinfection, Pilot plants, Adsorption, Water treatment, Temperature effects, Gas chromatography, Organic compounds.

Capillary gas chromatograms of 200-300 peaks were compared using chi-square contingency tables in a study of effluents from a granular activated carbon water treatment pilot plant. Before contacting the carbon, the water (from the Delaware River at Philadelphia, Pa.) was treated by clarification, rapid sand filtration, ozonation, and ozone dissipation. The anlaytical methods were devised to determine the significant differences at p= 0.05 of chromatograms of (1) influent vs. effluent composite samples, (2) influent vs. effluents of the activated carbon columns, (3) location of trace organics on columns, and (4) effects of differences in water temperature on trace organics removal. The following conclusions were drawn. Replicate carbon contactors had reproducible effluent gas chromatogram profiles. Influents to the columns were variable in weeks 3-5, after which they were homogeneous (weeks 6-13). Effluents for weeks 3-11.5 were homogeneous. Effluents were different at the different temperatures. At week 9 core samples from the carbon columns showed differences between warm and cooled water. Chlorinated organics were observed in the influent to the carbon columns and on the surface of the carbon. No chlorinated organics were found in the effluents during the 18-week study. (Cassar-PTT)
W86-02165

INFLUENCE OF PRECHLORINATION ON THE AMOUNT AND TOXICITY OF MICROPOLLUTANTS EXTRACTED FROM WATER AT THE MORSANG PLANT,
Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
F. Fiessinger, R. Cabridenc, I. Chouroulinkov, B. Festy, and P. Lazar.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 467-481, 4 fig, 5 tab, 6 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Activated carbon, *Organic compounds, Adsorption, Morsang, France, Toxicity, Clarification.

Studies of the Morsang, France, water treatment plant from 1977 to 1980 concerned organic pollutants and the roles of prechlorination and granular activated carbon adsorption. The following conclusions were reached. (1) Prechlorination increased the intrinsic toxicity and hindered reduction of the amount of extracted pollutants in the finished water. Overall activity of the extracts (intrinsic toxicity times relative amount) was reduced by 50% with prechlorination and 85% without prechlorination. (2) Activated carbon applied at low doses did not influence short-term toxicity but seemed to reduce long-term toxicity. In all cases it enhanced the reduction of the weight of extract in the finished water. (3) Clarification (coagulation + flocculation + sedimentation + sand filtration) reduced the extract weight but increased its intrinsic toxicity. Clarification preferentially removed the less harmful substances. (Cassar-PTT)
W86-02168

FORMATION OF ORGANOHALOGEN COMPOUNDS IN CHLORINATED SECONDARY WASTEWATER EFFLUENT,
Florida International Univ., Miami. Drinking Water Quality Research Center.
W. J. Cooper, J. T. Villate, E. M. Ott, R. A. Slifker, and F. Z. Parsons.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry

and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 483-497, 3 fig, 9 tab, 6 ref. 80-034.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Chlorination, Trihalomethanes, Chlorinated hydrocarbons, Brominated hydrocarbons, Organic compounds, Goulds-Perrine Treatment Plant, Virginia Key Treatment Plant, Florida.

The effects of chlorinating wastewater effluents was studied at several Miami, Florida, secondary treatment plants. Chloroform and brominated trihalomethanes were formed before and after the chlorination breakpoint. The concentration of individual trihalomethanes tended to follow the breakpoint curve; lower concentrations were found near the breakpoint. Bromides were present in wastewater from the Virginia Key plant, a result of sea water intrusion into the collection system. A clear trend in the rate of trihalomethane formation with respect to chlorine added was not obtained. (Cassar-PTT)
W86-02169

NONVOLATILE ORGANICS IN DISINFECTED WASTEWATER EFFLUENTS: CHEMICAL CHARACTERIZATION,
Oak Ridge National Lab., TN.
R. L. Jolley, R. B. Cumming, N. E. Lee, L. R. Lewis, and J. E. Thompson.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 499-523, 4 fig, 2 tab, 25 ref. EPA-IAG-D7-01027.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Disinfection, *Organic compounds, Chlorination, Ozonation, Ultraviolet radiation, Toxicity, Mutagens, Chromatography, Oxidation.

Disinfection of secondary and tertiary effluents by chlorination destroyed some nonvolatile organic constituents and produced others in the majority of samples examined. Mutagenicity of certain fractions was similarly affected. Ozonation both destroyed and produced some nonvolatile organic compounds, including those showing mutagenic activity. Ultraviolet radiation had a definite but slight effect on nonvolatile organic constituents; it decreased mutagenicity in some effluents and increased it in others. Chemical composition and mutagenicity varied with plant and the date sampled. A total of 106 nonvolatile compounds were identified in the concentrates of control and disinfected effluents. The mutagenic fraction contained 70 constituents; the nonmutagenic fraction, 65. Twenty-nine constituents were found in both mutagenic and nonmutagenic fractions. No known mutagens were identified in the mutagenic fractions from undisinfected, chlorinated, ozonated, and ultraviolet-irradiated effluents. Phosphate identified in the chromatographic fractions was attributed to degradation during trimethylsilylation or anion exchange preparation. (Cassar-PTT)
W86-02170

FORMATION OF VOLATILE HALOORGANIC COMPOUNDS IN THE CHLORINATION OF MUNICIPAL LANDFILL LEACHATES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
J. P. Gould, R. E. Ramsey, M. Giabbai, and F. G. Pohland.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 525-539, 5 fig, 5 tab, 31 ref. A-088-GA.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Chlorination, *Leachates, *Landfills, Organic compounds, Trihalomethanes.

Leachate, obtained from a simulated landfill lysimeter, was chlorinated at doses up to 600 mg/liter chlorine. The landfill consisted of codisposed metal plating sludge and municipal solid waste. The leachate on day 697 after landfilling had a COD of 4291 mg/liter and BOD of 2150 mg/liter. The chlorine demand curve showed a sharp rise in chlorine residual at about 500 mg/liter chlorine dose. A leachate with initial COD of 4875 mg/liter showed increasing COD removal up to about 28% at the maximum chlorine dose of 600 mg/liter. Organisms were not fully removed (8000/ml remaining) even at the 400 mg/liter chlorine dose. Chlorination of the leachate produced a complex mixture of volatile haloorganic compounds, only one of which (methylene chloride) was found in the unchlorinated leachate. Among the products were 1-chloro-4-methylbenzene; chlorobenzene; 2-chloroethylbenzene; benzonitrile; trihalomethanes; halogenated ethanes, propanes, butanes, and heptanes; ketones; halogenated aromatics; and a number of unknown compounds. Until further data are collected, hypochlorous acid should be used cautiously as a disinfectant for landfill leachates. (Cassar-PTT)
W86-02171

NEW APPROACHES TO THE PRODUCTION OF 36 CL-LABELED CHLORINATING AGENTS AND THE MEASUREMENT OF 36CL INCORPORATED INTO BIOLOGICAL MATERIALS,
Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
For primary bibliographic entry see Field 5A.
W86-02172

HAZARDOUS WASTE MANAGEMENT FOR THE 80'S.
For primary bibliographic entry see Field 5E.
W86-02219

ENVIRONMENTAL 'TERMITE' INSPECTIONS,
For primary bibliographic entry see Field 5A.
W86-02223

GROUND-WATER MONITORING AT AN INDUSTRIAL WASTE DISPOSAL SITE IN PENNSYLVANIA,
N. L. Circhowicz, R. M. Cadwgan, and J. R. Ryan.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 389-402, 8 fig.

Descriptors: *Waste disposal, *Groundwater pollution, *Geohydrology, Groundwater, Groundwater movement, Industrial wastes, Benzenes, Environment, On-site investigations, Water analysis.

A two-phase hydrogeologic investigation was carried out at a former industrial waste disposal site in Pennsylvania. Coal-coking sludge, agricultural chemical residue, and desulfurization waste are among the wastes disposed of in trenches at the 35 acre site, located on the tip of a river island. The purpose of Phase I of the study was to determine a preliminary estimate for the discharge rate of organic contaminants to the river via ground water. This was achieved by using data on the flow and quality of groundwater collected at 46 locations beneath, and adjacent to, the site. Benzene was found to be the dominant compound, showing a discharge rate of about 2 lb/day into the river from groundwater. Phase II was designed to better define the hydraulic gradient by continuously monitoring ground and river water levels. The hydraulic gradient of the water table was found to be typically toward the river, and over a two-month period, during low-flow conditions, averaged 0.0015. The direction of groundwater flow was toward the site for approximately six days during the same two-month period at a maximum gradient of 0.0058. (Halterman-PTT)
W86-02231

CASE HISTORIES OF GROUNDWATER ASSESSMENT,
Burgess and Niple Ltd., Columbus, OH.
J. A. Barker-Stonerock.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, I, 1982. p 403-420, 2 fig, 6 tab.

Descriptors: *Groundwater pollution, *Waste disposal, *Industrial wastes, *Landfills, Environment, On-site investigations, Groundwater movement, Water quality, Water sampling, Water analysis.

Case histories of groundwater assessment performed for a variety of purposes (assessment for landfill development, for abandoned landfill, and for surface impoundments) are presented. Groundwater assessments typically include the following: a review of existing water quality data to determine local groundwater quality; performance of test borings and laboratory testing on earth materials obtained during drilling; installation of monitoring wells at those locations where geologic and groundwater conditions indicate the best information may be obtained; estimation of rate of groundwater movement based on transmissivities; collection of water samples from completed monitor wells and analysis in laboratory for specified parameters; and preparation of final report to determine whether additional testing is required. The case histories presented illustrate the need for tailoring the study techniques to meet the individual requirements of each disposal site. (Halterman-PTT)
W86-02232

CHLORINATED DIOXINS AND DIBENZOFURANS IN THE TOTAL ENVIRONMENT,
For primary bibliographic entry see Field 5A.
W86-02233

2,3,7,8-TETRACHLORODIBENZO-P-DOXIN AND 2,3,7,8-TETRACHLORODIBENZOFURAN RESIDUES IN GREAT LAKES COMMERCIAL AND SPORT FISH,
Health and Welfare Canada, Ottawa (Ontario).
J. J. Ryan, P-Y. Lau, J. C. Pilon, and D. Lewis.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston, 1983. p 87-97, 1 fig, 4 tab, 10 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Chlorinated dioxins, *Chlorinated dibenzofurans, Chemical Analysis, Gas chromatography, Chromatography, Mass spectrometry, Public health, Ecosystems, Ecology, *Great Lakes, *Fish.

Residues of 2,3,7,8-tetrachlorodibenzo-p-dioxin (tetra-CDD)and 2,3,7,8-tetrachlorodibenzofuran (tetra-CDF) were studied in commercial fish and sportfish in the Great Lakes, primarily Lake Ontario, during 1979 and 1980. For the samples with positive results, tetra-CDD ranged from 2.0 to 38.5 ppt, with catfish, eel and smelt having the highest levels. The levels of tera-CDF ranged from 3.2 to 200 ppt, with smelt, salmon and rainbow trout having the highest concentrations. Overall, 25% of the 62 fish sampled had concentrations of these compounds greater than 10 ppt. The highest concentrations were associated with high polychlorinated biphenyls and lipid content of the fish. (Halterman-PTT)
W86-02234

OCCURRENCE OF TETRACHLORODIBENZO-P-DIOXIN IN ENVIRONMENTAL SAMPLES FROM SOUTHWEST MISSOURI,
Environmental Protection Agency, Kansas City, MO. Region VII.
For primary bibliographic entry see Field 5A.
W86-02236

CHLORINATED DIOXINS AND DIBENZOFURANS IN THE TOTAL ENVIRONMENT II.
For primary bibliographic entry see Field 5A.
W86-02240

HISTORICAL RECORD OF POLYCHLORINATED DIOXINS AND FURANS IN LAKE HURON SEDIMENTS,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 5A.
W86-02241

ANALYSIS OF PCDD-PCDF IN ENVIRONMENTAL SAMPLES,
Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 5A.
W86-02242

OCTANOL-WATER PARTITION COEFFICIENT OF 1,3,6,8-TCDD AND OCDD BY REVERSE PHASE HPLC,
Manitoba Univ., Winnipeg. Dept. of Soil Science.
For primary bibliographic entry see Field 5A.
W86-02243

BIOAVAILABILITY OF 14C-1,3,6,8-TETRACHLORODIBENZO-P-DIOXIN AND 14C-OCTACHLORODIBENZO-P-DIOXIN TO AQUATIC INSECTS IN SEDIMENT AND WATER,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, B. E. Townsend, and G. R. B. Webster.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Butterworth Publishers, Boston, 1985. p 89-102, 3 fig, 4 tab, 28 ref.

Descriptors: *Chlorinated hydrocarbons, *Aquactic insects, *Hydrocarbons, *Biological magnification, Polychlorinated dibenzo-p-dioxins, Ecosystems, Aquatic environment, Insects, 1,3,6,8-tetrachlorodibenzo-p-dioxins, Ocatachlorodibenzo-p-dioxin.

The uptake, elimination and bioconcentration of 1,3,6,8-tetrachlorodibenzo-p-dioxin (1,3,6,8-TCDD) and octachlorodibenzo-p-dioxin (OCDD) by five species of aquatic insect were compared in the laboratory in two types of sediment. The purpose was to assess how bioavailability of polychlorinated dioxins (PCDD) in aquatic systems could be influenced by the physical properties of the chemicals, the characteristics of the physical environment, and the characteristics of the animals. Total radioactivity in each animal, and water concentrations of radioactive 1,3,6,8-TCDD abd OCDD were determined using liquid scintillation counting, and bioconcentration factors for each chemical and aquatic insect were calculated from 96 hr. exposure data. Bioconcentration of 1,3,6,8-TCDD and OCDD by aquatic insects was much less than predicted, possibly due to overestimation of the concentration present in water in a bioavailable form. OCDD was poorly accumulated by all animals studied (possibly due to strong sorption to sediment and to poor absroption due to steric factors). The differences in the bioconcentration factors among the various insects studied are discussed in relation to differences in feeding habits and metabolism. The results confirm that PCDD other than 2,3,7,8-TCDD can be mobilized by sediment-dwelling animals. (Halterman-PTT)
W86-02244

PART PER TRILLION RESIDUES OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN MICHIGAN FISH,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
S. W. Kaczmar, M. J. Zabik, and F. M. D'Itri.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Butterworth Publishers, Boston, 1985. p 103-124, 7 fig, 2 tab, 11 ref.

Descriptors: *Chlorinated hydrocarbons, *Fish, *Carp, *Sucker, *Hydrocarbons, Polychlorinated dibenzo-p-dioxin, 2,3,7,8-tetrachlorodibenzo-p-dioxin, Ecosystems, Aquatic environment, Michigan.

A study was carried out to determine whether 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) residues exist in selected Michigan fish samples in areas other than the previously-sampled Tittabawassee River watershed. Samples of carp (Cyprinus carpio) and sucker (Carostomus commersoni) were collected by electroshock at 31 sampling sites in the lower peninsula of Michigan. Samples were extracted, purified, then analyzed for 2,3,7,8-TCDD by gas chromatography-mass spectrometry (with a detection limit of 20 picograms). Detectable residues of 2,3,7,8-TCDD ranged from 17 to 586 ng/kg. Residues of 2,3,7,8-TCDD were detected in fish collected upstream to the chlrophenol manufacturing facility in Midland, and from other portions of the state in entirely different watersheds. The results suggest that low-level contamination of bottom-feeding fishes is relatively widespread in the industrialized portions of the state. (Halterman-PTT)
W86-02245

PCB'S: HUMAN AND ENVIRONMENTAL HAZARDS,
Butterworth Publishers, Boston. 1983. Edited by Frank M. D'Itri and Michael A. Kamrin. 443 p.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish.

Polychlorinated biphenyls (PCBs) have been used for industrial purposes for over 50 years. Research on the ecology and human health impact of these compounds has, however, been conducted only since 1966. This volume presents varied viewpoints on the hazard of these compounds, the latest research findings, and an overview of the steps that are being taken to solve PCB-related problems in the environment, with an emphasis on the Great Lakes region. The volume stresses five major aspects fo PCBs: (1) background, scientific, social and political information that is important to understand the PCB contamination problem; (2) the current state of the art with respect to chemical analysis and monitoring; (3) information on the metabolism, biotransformation, toxicology and persistence of PCBs; (4) effects of PCBs on human health; and (5) the roles of Federal and state agencies in the regulation of PCBs. (Halterman-PTT)
W86-02248

PCB PROBLEM: AN OVERVIEW,
Michigan State Univ., East Lansing.
J. E. Cantlon.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 5-10.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish.

The global contamination of the environment with organics began with the burgeoning of industrial chemistry between World Wars I and II and picked up substantially both in diversity of hazardous materials and in the tonages that were released into the earth's hydrosphere, atmosphere, lithosphere, and biosphere after World War II. The halogentated hydrocarbons were manufactured for various kinds of industrial uses, including pesticides, inks, cutting oils, and heat exchange fluids. Among these hydrocarbons are the polychlorinated biphenyls (PCBs), which now appear in the tissues of most living organisms as well as in air, water, soils, and sediments over most of the earth. The Great Lakes have been a particularly interesting contamination area, with substantial food-chain concentrations of these highly fat-soluble compounds. While the manufacture of PCBs is now prohibited in the United States, the size of the environmental burden in waters, sediments, soils, disposal sites, and in deployed transformers and other containers of PCBs is very large, estimated to be 82 million kg. Several observations on these processes are offered. First, research results that bear on urgent decisions rarely have the luxury of science's normal process. Second, decision-makers are often subject to strong public pressures, predominantly from one side or the other, in arriving at their decisions. Third, on occasion, one organization holds both developmental and regulatory responsibilities. (Halterman-PTT)
W86-02249

OVERVIEW OF THE SCIENTIFIC BASIS FOR CONCERN WITH POLYCHLORINATED BIPHENYLS IN THE GREAT LAKES,
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
W. R. Swain.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 11-48, 6 fig, 8 tab, 56 ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish.

The ubiquitous distribution of residue-forming xenobiotic substances, particularly organochlorine compounds, including polychlorinated biphenyls (PCBs) is rapidly becoming apparent. Widespread dissemination is suggested by a variety of studies of areas presumably remote from the direct industrial and/or cultural influences attributable to man, including melting snow in the Antarctic, mammals of the Artic, in the surface waters and atmosphere above the Sargasso Sea, and inthe sediments of Siberian Lake Baikal. Although a number of these compounds have been banned, or their use has been severely restricted, they are still routinely reported in the Great Lakes basin. The identical characteristics of PCBs which made them industrially desirable, also makes them persist and accumulate in the environment. They are resistant to acid-base reactions, hydrolysis, chemical oxidation, photodegradation, thermal changes, and most chemical agents. Furthermore, they bond tightly to particulate matter such as soils and sediments; they have 8-15 year half-lives; they are extremely soluble in oils and fats, thus they tend to partition into biologic tissue. Several reasons for the particular susceptibility of the Great Lakes to PCBs are listed, and an extensive literature review of data on PCBs observed in fish of the Great Lakes is provided. Various aspects of human health hazards pertaining to PCBs are discussed, including the possiblity of PCBs persisting in the human population for as long as 5 to 8 generations into the future. (Halterman-PTT)
W86-02250

PCBS IN THE GREAT LAKES: SOURCES, SINKS, BURDENS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
S. J. Eisenreich, and T. C. Johnson.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 49-75, 4 fig, 10 tab, 55 ref. R805172-01 R806084-01.

Descriptors: *Polychlorinated biphenyls, *Great Lakes, *Distribution patterns, *Ecological distribution, Distribution reservoirs, Chemical analysis, Water analysis, Monitoring, Sediment-water interfaces, Interfaces, Mud-water interfaces, Air-water interfaces.

Information on the polychlorinated biphenyl (PCB) sources, sinks, and burdens in the Great Lakes is summarized. A mass balance model is described which provides an understanding of the transport and distribution of PCBs in the lakes and an estimate of the residence time that they remain in the ecosystem, or in any compartment. The compartments include the atmosphere, hydroshpere, sediments, and lithosphere. The atmosphere does not represent a significant reservoir of PCBs in the Great Lakes, but appears to be a major pathway of input into the hydrosphere. Sediments, however, are the ultimate sink for PCBs in the Great Lakes. The lower lakes, especially Erie and Ontario, have the highest concentrations, ranging from 50-60 ng/g. The Upper Great Lakes exhibit ranges of concentrations from 3 to 10 ng/g. The upper 0.5 cm of sediment appears to have the highest concentrations within the lakes. The PCB burden for all the Great Lakes combined was estimated to be 417,000 kg in sediments, 25,000 to 87,000 kg in water, and 200 kg in the atmosphere. The principal sources of PCBs to the Great Lakes are atmospheric deposition, tributary input, and municipal/industrial discharges. Considerable uncertainty still exists in estimating fluxes at air/water and sediment/water interfaces. (Halterman-PTT)
W86-02251

ENVIRONMENTALIST'S VIEW OF THE PCBS IN THE GREAT LAKES,
Michigan United Conservation Clubs, Lansing.
T. L. Washington.
IN: PCB's: Human and Environmental Hazards, Butterworth Publisers, Boston, 1983. p 101-108, 9 ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish.

The non-scientific perspective of the concerns of laymen for the problems of polychlorinated biphenyls (PCBs) in the Great Lakes is presented. PCBs in the Great Lakes are particularly important for Michigan anglers. Although the salmon fishery, for example, is expanding, and is important to the tourist industry and to local anglers who consume large quantities of fish annually, there is little information of PCB levels in fish made available to the public. The public health hazards regarding contaminated fish are reviewed. The need for a vastly improved information base on PCBs and other contaminants in the Great Lakes environment, and an improved delivery system, to get that information to the general public, is called for. (Halterman-PTT)
W86-02252

EDIBLE TISSUE SAMPLING FOR FISH CONTAMINANT ANALYSIS,
Michigan Dept. of Natural Resources, Lansing. Surface Water Quality Div.
W. E. McCracken.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 123-139, 1 fig, 2 tab, 22 ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish, Michigan.

Considerable controversy exists over which method of preparation is best when fish are to be analyzed for contaminants such as polychlorinated biphenyls (PCBs). The state of Michigan's reasoning on this issue is discussed, along with Michigan's current fish contaminant monitoring program. The objectives of the program are to provide information for assessing potential human exposure to contaminants from consumption of fish; to determine chronological trends in fish contaminants; to identify new residues in fish: to communicate the results of these findings to appropriate government agencies; and to inform the public of public health advisories. The inconsistencies within federal and state testing programs are discussed, and the manner in which Michigan proposes to resolve the question are outlined. The proposed plan includes the determination of a standard edible portion which is specific for each species; and, the analysis of that portion of raw fish which would most likely be eaten after cooking. The various categories for testing include skin-on fillet for such fish as perch, walleye, basses, crappie and sunfishes; skin-off fillet for catfish, pike, whitefish, and trout; and headless, gutted common-sense approach to fish contaminant sampling when the objective is to determine amounts of consumable contaminants present in fish. (Halterman-PTT)
W86-02253

BIOTRANSFORMATION AND PERSISTENCE OF POLYCHLORINATED BIPHENYLS (PCBS) IN FISH,
Medical Coll. of Wisconsin, Inc., Milwaukee. Dept. of Pharmacology and Toxicology.
J. J. Lech, and R. E. Peterson.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 187-201, 9 fig, 14 ref. ES-01080 (JJL).

Descriptors: *Polychlorinated biphenyls, *Public health, *Chemical analysis, Great Lakes, Water analysis, Monitoring, Toxicity, Fish.

Available data indicate that most fish species biotransform the lower chlorinated polychlorinated biphenyl (PCB) congeners at slower rates than mammals. Generally, the overall residue patterns in fish resemble the patterns found in the exposure source. Furthermore, the degree of bioaccumulation of PCBs in fish may be directly related to the fat content of the species in question, and that the major mechanism for reducing PCB concentrations in fish is by dilution by growth, rather than by true elimination of a portion of the total body burden. (Halterman-PTT)
W86-02255

SALINITY IN WATERCOURSES AND RESERVOIRS,
Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity. July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston. 1984. 622 p. Edited by Richard H. French.

Descriptors: *Salinity, *Saline water, *Groundwater, *Water quality, Irrigation, Water pollution, Dissolved solids, Percolation, Environmental effects, Agriculture, Economic aspects, Legal aspects.

A series of papers pertaining to salinity in watercourses and reservoirs is presented. Specific topics include salinity control policy and planning, salinity sources and problems, salinity data base analysis, modeling applied to salinity problems, salinity control programs in agriculture, non-agricultural salinity control programs, alternative uses of saline water, geochemical and geophysical methods of salinity detection, salinity control project mitigation, and secondary salinization. (Halterman-PTT)
W86-02264

COLORADO RIVER SALINITY - THE USER'S PERSPECTIVE,
Colorado River Board of California, Los Angeles.
M. B. Holburt.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 13-22.

Descriptors: *Colorado River, *Saline water, *Salinity, Irrigation, Flood irrigation, Irrigation practices, Water requirements, Irrigation requirements, Water softening, Water supply, Water use, Water users.

The concern over the Colorado River's comparatively high salt concentration is discussed. Of particular interest is the major economic detriments to both agricultural and urban water users in the lower Basin states (Arizona, California, Nevada) and northwestern Mexico. Steps to control the salinity, begun in 1929 and continuing to the present, are outlined. Measures to reduce the impact of salinity on urban and agricultural areas are discussed. Methods include the use of water softeners by domestic and commercial users, use of corrosion-resistant plumbing, installation of drain pipes in farm fields to carry away the salt, and the lining of laterals with concrete to decrease seepage. (Halterman-PTT)
W86-02265

PROBLEM OF SALINITY AND ITS CONTROL, RIVER MURRAY, AUSTRALIA,
River Murray Commission, Canberra (Australia).
T. A. O'Brien.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 33-42, 4 fig, 1 tab.

Descriptors: *Saline water, *Salinity, Water requirements, Water supply, Water use, Water users, River Murray, *Australia, Monitoring, Water quality management.

The problems of salinity in south-eastern Australia, with emphasis on the River Murray, are described. There are three types of problems discussed: the salinity of water diverted from the river and applied to crops; the salinisation of irrigated land caused by the development of high water tables; and, the salinisation of dry land. The problems which could be common to rivers which form the border between states, or countries, are highlighted. The continued viability of the River Murray, and its importance to Australia, and the priority of government funding are discussed. (Halterman-PTT)
W86-02267

SALINITY SOURCES AND PROBLEMS OF THE DANUBE RIVER BASIN,
North Dakota State Univ., Fargo. Dept. of Soil Science.
A. Maianu.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 105-114, 2 fig, 4 tab, 12 ref.

Descriptors: *Saline water, *Salinity, Irrigation, Water requirements, Water supply, Water users, Groundwater, *Danube River.

Various aspects of the salinity problems of the Danube River Basin are discussed. The primary source of salts is the weathering of tertiary, crystalline, volcanic and cretaceous rocks in the river basin in Czechoslovakia, Austria, Hungary, Yugoslavia, Romania, and the USSR. The salts are then carried to the Danube by surface and ground waters. The composition and concentrations of salts in surface and ground waters are summarized. The hazards of secondary salinization resulting from irrigation are discussed. (Halterman-PTT)
W86-02273

SOUTHWESTERN SALINITY SITUATION: THE ROCKIES TO THE MISSISSIPPI,
Army Engineer Div. Southwestern, Dallas, TX.
B. G. Rought.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 115-124, 2 fig, 4 ref.

Descriptors: *Saline water, *Salinity, Water requirements, Water users, Water use, Groundwater, Red River, Colorado River, Texas, Brazos River, Arkansas River, Pecos River, Desalination.

An overview of the salinity problem in the streams of the southwestern United States, from the Continental Divide to the Mississippi River, is presented. The quality of water in the mainstreams of a number of the river systems in this area is seriously degraded by salt emissions from major salt sources in the upper portion of their basins. Environmental and economic impacts of the salinity, including crop loss, increased municipal water treatment costs, and corrosion damage, are discussed. Potential solutions that are outlined include: importing fresh water, desalination, freshwater diversion, impoundment, and collection and disposal of brine. (Halterman-PTT)
W86-02274

ECONOMIC EVALUATION OF SALINITY CONTROL,
Corps of Engineers, Tulsa, OK.
For primary bibliographic entry see Field 6B.
W86-02275

NATURAL SALT POLLUTION CONTROL BRAZOS RIVER BASIN, TEXAS,
Army Engineer District, Fort Worth, TX.
J. A. McCrory.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 135-144, 6 fig, 3 ref.

Descriptors: *Saline water, *Salinity, *Desalination, Water requirements, Water users, Water use, Brazos River, Texas, Economic aspects.

Salt pollution from salt flats in the headwaters of the Brazos River has resulted in poor water quality in approximately 1500 kilometers of the main stem Brazos River from Stonewall County, Texas, to the Gulf of Mexico. The principal mineral pollutants considered in this study were chlorides, sulfates, and total dissolved solids. Various plans to control salinity in the Brazos River, including desalination, pipeline to the Gulf, and redistribution of existing water sources, are discussed. It appears

that desalination by impoundment evaporation techniques presents the most cost effective solution. (Halterman-PTT)
W86-02276

SALINITY BALANCE OF THE LOWER VIRGIN RIVER BASIN, NEVADA AND ARIZONA,
Montana Univ., Missoula. Dept. of Geology.
W. W. Woessner, M. D. Mifflin, R. H. French, A. Elzeftawy, and D. E. Zimmerman.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 145-156, 2 fig, 1 tab, 15 ref.

Descriptors: *Salinity, *Saline water, *Phreatophytes, Groundwater, Total dissolved solids, Virgin River, Nevada, Arizona, Monitoring, Water use, Water users, Water pollution sources.

This 12 month study developed additional hydrologic data for the development of salinity budgets in the Lower Virgin River Valley, Nevada and Arizona, a tributary of the Colorado River. Monthly stream gaging at six locations, groundwater monitoring at existing and new sites, water-quality sampling and soil sampling were included. Results indicate a complex hydrologic system with concentration, storage, and transport of salt occurring iin the study area. Water and salt budget analyses indicate a 36% net loss of water and a 34% net loss in salt for a 61 km reach of river. The majority of water loss is attributed to phreatophyte consumptive use. Salt concentration associated with phreatophyte comsumptive use exceeded consumptive concentration of salt by agriculture and direct evaporation by 2.6 times. Data indicate that phreatophyte areas play a major role in salt accumulation and storage by consumptively utilizing 2.1 to 3.6 m of water per year. TDS concentrations of 5,800 to 11,000 mg/l were measured in the shallow groundwater underlying phreatophyte areas. (Author)
W86-02277

GRAND VALLEY SALT PICK-UP CALCULATIONS,
Bureau of Reclamation, Grand Junction, CO.
R. R. Inman, D. C. Olson, and D. L. King.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 157-167, 2 fig, 4 tab, 2 ref.

Descriptors: *Salinity, Saline waters, Groundwater, Total dissolved solids, Monitoring, Water use, Grand Valley, *Colorado, *Colorado River, Water pollution sources.

The quantification of salt loading from the Grand Valley in western Colorado, based on an analysis of an inflow-outflow river budget, is presented. The Grand Valley contributes approximately 6 percent of the average salt loading to the Colorado River. An average salt pickup of 528 million kg/yr was determined through analysis of salt and water budgets over a 29 year period. A 95 percent confidence limit on the mean of + or - 84 million kg/yr was established. No significant trend in salt pickup was identified. The Colorado-Utah State Line gage was determined to be the most appropriate gage for estimating the Colorado River outflow. Outflows were adjusted so that the unaccounted flow was zero, which provided a better estimate of salt pickup. (Halterman-PTT)
W86-02278

IMPACT OF RESERVOIRS ON SEASONAL AND HISTORICAL SALINITY OF THE COLORADO RIVER,
Bureau of Reclamation, Salt Lake City, UT.
D. P. Trueman, and J. B. Miller.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 171-180, 4 fig, 3 tab, 9 ref.

Descriptors: *Saline water, *Salinity, Water requirements, Water users, Groundwater, *Colorado River, Desalination, Reservoirs, Multipurpose reservoirs.

The historical perspective of water resources development is presented and the impacts of reservoirs on salinity and the salinity control are evaluated. The increased development of reservoirs over the last several decades has resulted in an increased retention time of Colorado River water to the range of 4-6 years. This retention time has decreased both the seasonal and annual variability of salinity in the basin. Predicted increased discharges will effectively dilute the salinity in the lower basin. Future development, however, in the upper basin, will eventually reduce the flow through the system and cause increased salinity levels. (Halterman-PTT)
W86-02279

HISTORICAL TRENDS IN CONCENTRATION AND LOAD OF MAJOR IONS IN THE COLORADO RIVER SYSTEMS,
Bureau of Reclamation, Denver, CO.
D. K. Mueller, and C. D. Moody.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 181-192, 4 fig, 1 tab, 10 ref.

Descriptors: *Salinity, *Saline water, Model studies, *Colorado River, Water pollution, Solids, Discharge measurements.

A data base development procedure which allows maximum use of existing data to determine reasonable estimates of monthly mean solute concentrations, loads, and mass fractions is described. The data analysis included a regression of seasonal values. Interpretation of results of such analyses is based on several general observations, including: differences between regulated and unregulated sites are clearly seen; significant mean value differences are easier to identify than temporal trends in monthly data; trends are more easily identified for low flow periods, probably due to smaller variance in discharge data; changes in concentration, load and mass fraction are associated with river discharge; several dependent variables appear for solute changes; and no single dependent variable is clearly preferable for identification of changes or trends. (Halterman-PTT)
W86-02280

EFFECT OF ASSUMPTIONS ON MODEL CALIBRATION AND PREDICTION,
Utah Water Research Lab., Logan.
E. K. Israelsen.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 195-201.

Descriptors: *Salinity, *Saline water, *Model studies, Agriculture, Groundwater, Mathematical models, Water pollution sources.

Background information on mathematical descriptions of processes and functions, computer algorithms, and model applications precede a discussion of the effects of assumptions on calibrations and predictive capability of models. Several alternative assumptions used in models concerning salinity are presented, and the subsequent variability in the results is demonstrated. The belief is stated that models will not indicate all the problems of fitting to the real system or any indication of feedback impacts. Furthermore, since models will not indicate all problems, they sometimes make predictions that are not correct, but the model links all the processes together so that the impacts of one process on another show up most of the time. Finally, although models are superior to single process calculations, they are not yet perfect and are subject to making errors as directed by the modeler. (Halterman-PTT)
W86-02281

LONGITUDINAL-VERTICAL HYDRODYNAMICS AND TRANSPORT WITH CHEMICAL EQUILIBRIA FOR LAKE POWELL AND LAKE MEAD,
Edinger (J.E.) Associates, Inc., Wayne, PA.
J. E. Edinger, E. M. Buchak, and D. H. Merritt.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston, 1984. p 213-222, 5 fig, 1 tab, 6 ref.

Descriptors: *Salinity, *Saline water, *Water pollution sources, Model studies, Lake Powell, Lake Mead, Colorado River, Carbonates, Imperial Dam, Reservoir operation.

The hydrodynamic features and numerical properties of the LARM longitudinal and vertical hydrodynamic and transport model are presented and its use in Lakes Powell and Mead are discussed. The model produces extensive, detailed results including outflow conditions, evaporation rates and detailed circulation patterns for Lake Powell. The use of the model to construct carbonate chemistry in Lake Mead is also described. Data show that there are gypsum sources along the reservoir that can add calcium and sulfate to the system and shift the carbonate balance. Future uses of the model by the Bureau of Reclamation, for assessing long-range impacts of Lake Mead and Lake Powell on the Colorado River system, are described. This is important because projections of future salinity increases and requirements for salinity control are presently based upon the assumption that the reservoirs exert no change on salinity other than concentration by evaporation. (Halterman-PTT)
W86-02283

CONCEPTUAL MODELS OF GEOLOGIC AND AGRICULTURAL SALT LOADS IN STREAMS OF THE UPPER COLORADO RIVER BASIN,
Utah Water Research Lab., Logan.
C. J. Duffy.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 223-233, 4 fig, 5 ref.

Descriptors: *Saline water, *Salinity, *Irrigation, Modeling studies, Colorado River, Groundwater, Furrow irrigation, Irrigation effects, Environmental effects, Irrigation engineering, Irrigation practice.

Some specific aspects of the interaction and mixing of groundwater from near surface saline strata, and infiltration of water and solutes from irrigation are discussed. Subsurface transport in unconsolidated strata is modeled and salt transport in consolidated rocks is described. Preliminary calculations suggest that diffusion from consolidated sediments may contribute significant salinity to groundwater and streams in the region. Little is known, however, about the magnitude of diffusion coefficient, the effective porosity, and the concentration contrast between unconsolidated strata, all of which control the magnitude of this salinity source. Future research, including the exploration of the potential of diffusive salt loading, possibly a major factor in effective salinity control, is also discussed. (Halterman-PTT)
W86-02284

SALINITY CONTROL PROBLEMS ASSOCIATED WITH IRRIGATION IN SOUTH-WEST NEW SOUTH WALES, AUSTRALIA,
Water Resources Commission of New South Wales, Sydney (Australia).
A. van der Lelij, and S. E. Flint.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 265-274, 2 fig, 1 tab, 3 ref.

Descriptors: *Salinity, *Saline water, *Water pollution sources, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture.

In common with irrigation in many other semi-arid regions, irrigation schemes on the Riverine Plain of south-west New South Wales have resulted in rises in ground water levels which have created problems of soil salinization and waterlogging. The raised ground water levels can also lead to salt intrusion into streams and impairment of water quality if they are not controlled. Subsurface drainage presents problems of disposal of saline drainage effluent without increasing the salinity of water to unacceptable levels for downstream users. A range of effluent management options are to be evaluated to achieve the target salinity of 0.4 g/L at the downstream end of the system. These include

reuse of effluent upstream by discharge to, and dilution in, supply channels (limited scope because effluent salinity is often too high); dilution flows to reduce salinity downstream; diversion of the more saline winter drainage flows; on-farm retention of effluent during the irrigation season; disposal of some effluent in evaporation areas. (Halterman-PTT)
W86-02288

CASE STUDY OF A SALINITY CONTROL PROGRAM, VINTA BASIN, UTAH,
Soil Conservation Service, Salt Lake City, UT.
For primary bibliographic entry see Field 5G.
W86-02289

CHARACTERISTICS, TRENDS AND SURFACE WATER QUALITY IMPLICATIONS OF SALINE TILE EFFLUENT,
D. B. Harker.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 325-334, 4 fig, 14 ref.

Descriptors: *Salinity, *Saline water, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agriculture, Agricultural hydrology, Alberta, Canada, Saskatchewan River Basin.

The possible negative impact of future saline tile effluent on river water quality within Alberta, Canada is being studied. A network of on-farm tile drainage outlets has been regularly monitored for the past six years - to establish effluent quantities, qualities and apparent trends. Based on general trends, tile drainage is not expected to severely impact on river water quality within the foreseeable future. Some short-term negative impact may occur during periods of extremely low river flow, however. Long-term chemical data from individual sites has annual cycles and multi-year trends otherwise masked by site averaging. Such information indicates that site-specific data could be critical to accurately project seasonal and long-term effluent impact on small receiving systems. (Author)
W86-02294

MEEKER DOME SALINITY INVESTIGATION,
CH2M Hill Central, Inc., Denver, CO.
C. F. Feast.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 359-365, 3 fig, 1 tab, 3 ref.

Descriptors: *Saline water, *Salinity, *Water pollution sources, *Water quality control, Groundwater, Water supply, Environmental effects, Well hydraulics, Economic aspects, White River, Colorado, Saline aquifers.

Following the drilling of exploratory oil wells, saline water rose through uncased bore holes and recharged an unsaturated aquifer. This led to a drastic increase in salt loading into the nearby White River. Prior to the drilling, the salt load of the White River was 4.5 million kg per year; after drilling, salt loading reached a high of 24 million kg per year. Immediately following cementing of the bore holes, water in the upper aquifer began falling rapidly. An 80% decrease in salt loading into the White River was observed within one year of plugging the wells. On the basis of the reduction in salt loading, the program has had a benefit-to-cost ratio of 5 to 1. This ratio is expected to increase if the saline flows continue to decrease. (Halterman-PTT)
W86-02297

PRICE/SAN RAFAEL RIVER BASINS SALINITY INVESTIGATION,
CH2M/Hill, Boise, ID.
B. A. Johnson, and J. A. Riley.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 407-416, 1 fig, 3 ref.

Descriptors: *Saline water, *Salinity, *Water pollution sources, *Water quality control, Model studies, Groundwater, Water supply, Irrigation, Monitoring, Water use, Cooling water.

Investigations into the agriculture-related contribution of salt to the San Rafael and Price River Basins are discussed. The study approach consisted of analysis of existing data, development of hypotheses concerning salt loading mechanisms, collection of field data to verify quantities and sources of salinity, and formulation and analysis of viable alternatives. Results of the investigations indicate that the most cost effective options include a combined plan for on-farm irrigation improvements and winter water system improvements; collecting and using the drainwater for cooling, using binary cooling tower technology; and, collecting and using the drainwater to develop tar sands. The need for additional research to confirm yields from irrigation drains, to demonstrate the use of saline wqter in binary cooling towers, to refine the use of saline waters in tar sand development, to develop mitigation plans, to refine on-farm efficiencies, and to understand groundwater interactions is stressed. (Halterman-PTT)
W86-02302

STUDY OF SALINITY PRODUCTION FROM WILDLANDS OF PRICE RIVER BASIN, UTAH,
Unitex Corp., Salt Lake City, UT.
A. Lin.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 417-426, 4 fig, 3 tab, 6 ref. YA553-CTI-1064.

Descriptors: *Salinity, *Saline water, Shales, Gypsum, Watersheds, Ephemeral streams, Intermittent streams, Price River Basin, Utah.

Some essential results of a study of salinity production from wildlands are described. The major soluble mineral in Mancos shale is gypsum, with varying quantities of other sulfate minerals. For overland flows, solute pick-up increases as sediment concentration increases and as hill slope increases. Heavy solute pick-up in channels is a function of proximity to Mancos shale. Saline crust accumulations constitute a major source of salts to storm runoff and the estimated storm-related salt load contributed from wildlands ranged from 1% to 50%. The study confirms the importance of hillslope erosion in sediment and salinity production of the study area. (Halterman-PTT)
W86-02303

GEOCHEMICAL IDENTIFICATION OF SALINITY SOURCES,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5A.
W86-02309

DETECTION OF SUBSURFACE SALINITY WITHIN THE NORTHERN SLOPES REGION OF VICTORIA, AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 7B.
W86-02310

CHEMICAL REACTIONS INFLUENCING SALINITY INCREASE OF SOIL AND GROUNDWATERS IN THE GREAT BASIN, WESTERN UNITED STATES,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2K.
W86-02311

ANALYSIS OF SALT YIELDS ASSOCIATED WITH THE CONSTRUCTION AND OPERATION OF PARIETTE DRAW WILDLIFE AREA, UTAH,
Bureau of Land Management, Denver, CO.
For primary bibliographic entry see Field 4C.
W86-02313

SECONDARY SALINIZATION OF WATER RESOURCES IN SOUTHERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 4C.
W86-02315

SALINITY CONTROL PROBLEMS: NON-AGRICULTURAL,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
D. F. Peterson.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 583-592.

Descriptors: *Salinity, *Saline water, Groundwater, Water pollution, Seepage control, Seeps, Environmental effects, Groundwater movement.

A summary and critique of fifteen papers, concerning non-agricultural issues of salinity control, is presented. The topics of the papers fall into three categories: salinity sources and problems, salinity control programs, and salinity control project mitigation. 'Salinity sources' covers the Danube Basin and the southwestern United States. 'Salinity control programs' focuses on the Colorado River, Smokey Hill River in Kansas, the Red and Arkansas Rivers, and the general problems of 'produced' water in Kansas. Salinity control project mitigation focuses on a variety of problems in Arizona, California, Montana, and Australia. Technology, economic analyses, and institutionalization, as they relate to salinity control, are discussed. (Halterman-PTT)
W86-02316

CRITIQUE - SALINITY CONTROL PROBLEMS: AGRICULTURAL,
Science and Education Administration, Fort Collins, CO. Agricultural Research.
M. E. Jensen.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 597-608, 2 tab.

Descriptors: *Salinity, *Saline water, Groundwater, Water pollution, Seepage control, Seeps, Environmental effects, Groundwater movement, Agriculture, Agriculture watersheds.

Several papers pertaining to salinity control are reviewed and critiqued. Areas such as upstream vs. downstream users, long-term indicators of emerging problems, barriers to implementing control measures, the role of irrigated agriculture, water consumption by flood plain vegetation, and salt removal are reviewed. Possible distribution of river basin water costs is explored, and specific examples are provided for illustration of the concept. (Halterman-PTT)
W86-02317

SOURCE MOVEMENT AND EFFECTS OF NITROGEN AND PHOSPHORUS IN THE HEADWATERS OF HOP BROOK, MARLBOROUGH, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
J. C. Briggs, and W. D. Silvey.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4017, 1984. 5 p, 3 fig, 17 tab, 25 ref.

Descriptors: *Water quality, *Ponds, *Nutrients, Eutrophication, Algal growth, Nitrogen phosphorus, Hager Pond, Grist Millpond, Carding Millpond, Hop Brook, *Massachusetts.

The headwaters of Hop Brook near Marlborough, Massachusetts, contain a series of three in-line ponds--Hager Pond, Brist Millpond, and Carding Millpond--which receive over half of their surface-water inflow as effluent from the Marlborough Easterly Wastewater Treatment Plant. These ponds have a history of summer algal blooms and fish kills. Water entering these ponds contains quantities of nitrogen and phosphorus far higher than the levels known to promote excessive growth of aquatic vegetation. As the water moves

through the three ponds, nitrogen levels decrease. Although some nitrogen is lost to the atmosphere by denitrification, the bulk of the nitrogen probably is retained in the pond sediments. There is a net decrease in phosphorus in the water leaving Carding Millpond compared to the water entering Hager Pond. However, during most sampling periods, the phosphorus concentration of water leaving Carding Millpond is still above the level known to cause excessive growth of aquatic vegetation in lakes. During certain summer periods, there appears to be release of some phosphorus from the sediments in Carding and Grist Millponds. No improvement in water quality of the three ponds can be expected until the concentrations of nutrients entering Hager Pond are reduced to levels that will not support excessive growth of aquatic vegetation. (USGS)
W86-02343

QUALITY AND QUANTITY OF URBAN RUNOFF AND ATMOSPHERIC DEPOSITION IN URBAN AREAS OF SALT LAKE COUNTY, UTAH, 1980-1981,
Geological Survey, Salt Lake City, UT. Water Resources Div.
R. C. Christensen, D. W. Stephens, G. E. Pyper, H. F. McCormack, and J. F. Weigel.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4011, 1984. 223 p, 11 fig, 36 tab, 22 ref.

Descriptors: *Urban hydrology, *Utah, *Urban runoff, *Organic pollutants, Sediment composition, Salt Lake County, *Atmospheric deposition, Storm characteristics, Salt Lake County.

Water of good quality from mountain streams is degraded as it moves through urban areas to the Jordan River in Salt Lake County, Utah. The impact of urban runoff and atmospheric deposition on the quality of water in those streams and in storm conduits and canals functioning as storm drains was evaluated using data collected during 1980-81. Atmospheric-wetfall loads for an average storm were as much as 10 pounds per acre for total solids, but the dissolved trace metals were generally present in insignificant quantities. Wetfall-deposition loads generally were greater than stormrunoff loads, indicating that a large quantity of the wetfall load remained as soil deposits. Acid rain fell in more than one-half of the storms sampled, most commonly in September and October. Dustfall concentrations reflected the composition of local soils, particularly with regard to iron, manganese, and chromium; but concentrations of cadmium, copper, lead, zinc, and chloride were considerably enriched. Monthly loads of dryfall solids reached a maximum of 62 pounds per acre in the Little Cottonwood Creek urban basin, but were of the same magnitude as total storm loads for a heavy rainfall. Urban runoff represented about 38 percent of the discharge in three canals. The water in the canals was poorer in quality than the water in the mountain streams. The impact of the canal discharges to the streams is slight, however, owing to their 'relatively small amounts.' Concentrations of sediment, suspended solids, suspended trace metals, phosphorus, and oxygen-demanding substances were much greater during storm runoff than under base-flow conditions. This report contains data for basin and storm characteristics and water-quality information for atmospheric deposition and urban runoff. (USGS)
W86-02346

NUTRIENT AND DETRITUS TRANSPORT IN THE APALACHICOLA RIVER, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. D. Mattraw, and J. F. Elder.
Available from Dist Branch, USGS 604 S. Pickett St Alexandria, VA 22304. USGS Water-Supply Paper 2196-C, 1984. 62 p, 27 fig, 32 tab, 62 ref.

Descriptors: *Nutrients, *Detritus, *Floodplains, Flood discharge, Wetlands, Hydrologic budget, Organic matter, Carbon, Nitrogen, Phosphorus, Water quality, Baseline studies, Swamps, *Florida, *Wetlands, *Apalachicola River, *Nutrient transport, *River quality assessment.

The Apalachicola River in northwest Florida flows 172 kilometers from Jim Woodruff Dam to Apalachicola Bay on the Gulf of Mexico. Fifteen percent of the Apalachicola basin is occupied by a bottom-land hardwood floodplain that is relatively undeveloped. The dense floodplain forest produces approximately 800 metric tons per square kilometer of litter fall annually. Spring floods of March and April 1980 carried 35,000 tons of the decaying litter fall (detritus) into Apalachicola Bay. The estuary is predominantly a detrial-based food-web ecosystem which produces important commercial quantities of oyster, shrimp, blue crab, and various species of fish. Two hundred fourteen thousand metric tons of organic carbon were transported into the bay during the 1-year study period, June 1979 to June 1980. Nitrogen transport during the same period was 21.5 x 10 (to the third) tons and phosphorus was 1.7 x 10 (to the third) tons. The Apalachicola River floodplain contribution to the annual transport of carbon, nitrogen, and phosphorus was 34,200 tons, 668 tons, and 197 tons, respectively. Sixteen percent of the organic carbon is derived from less than 1 percent of the Apalachicola-Chattahoochee-Flint River basin. (USGS)
W86-02356

RAINFALL-RUNOFF RELATIONSHIPS AND WATER-QUALITY ASSESSMENT OF COON CREEK WATERSHED, ANOKA COUNTY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-02370

HYDROGEOLOGY OF A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE NEAR SHEFFIELD, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02371

HYDROLOGY OF AREA 60, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, NEW MEXICO, COLORADO, UTAH, AND ARIZONA,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02382

LITERATURE REVIEW OF SURFACE-WATER QUALITY IN THE CUYAHOGA VALLEY NATIONAL RECREATION AREA, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
C. J. O. Childress.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-619, 1984. 30 p, 6 fig, 2 tab, 31 ref.

Descriptors: Streams, *Water quality, Literature review, Dissolved oxygen, Base flow, Storm runoff, Bed load, *Ohio, *Cuyahoga River basin, Cuyahoga Valley National Recreation Area.

The Cuyahoga Valley National Recreation Area in Ohio encompasses about 23 miles of the middle reach of the Cuyahoga River and parts of four major tributaries--Furnace Run, Brandywine Creek, Chippewa Creek, and Tinkers Creek. Water quality in this reach does not meet Ohio water-quality standards for dissolved oxygen, fecal bacteria, ammonia, and lead. Point sources and nonpoint sources of effluent contribute contaminants. On the basis of a review of scientific and technical literature, National Park Service management goals, and water-quality data collected recently by the U.S. Geological Survey, three subject areas in need of study have been identified: (1) the dissolved oxygen regime, (2) chemical quality of base flow and (3) quality of stormwater runoff. (USGS)
W86-02388

TIME OF TRAVEL, WATER QUALITY, AND BED-MATERIAL QUALITY FOR THE CUYAHOGA RIVER WITHIN THE CUYAHOGA VALLEY NATIONAL RECREATION AREA, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
C. J. O. Childress.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-4065, 1985. 49 p, 14 fig, 6 tab, 11 ref.

Descriptors: *Water quality, Biochemical oxygen demand, Dissolved oxygen, Coliforms, Streptococcus, *Traveltime, Dye releases, Trace elements, *Bottom sediments, *Streams, *Path of pollutants, *Ohio, *Cuyahoga River, Cuyahoga Valley National Recreation Area.

Three studies were conducted in the Cuyahoga Valley National Recreation by the U. S. Geological Survey to (1) establish the relationship between time of travel and discharge through the park reach of the Cuyahoga River, (2) characterize water quality of the Cuyahoga River within the park over a 24-hour period, and (3) determine general areas where the streambed might be contaminated by trace metals. Time of Travel between Botzum and Independence is described by the equation $T = 46.9\text{-}0.038Q$, where T = time, in hours, and Q = discharge at Independence, in cubic feet per second. On the main stem of the Cuyahoga River, dissolved-oxygen saturation was highest and ultimate carbonaceous biochemical oxygen demand was lowest on the upstream and downstream ends of the reach. Dissolved-oxygen saturation was more than 80 percent in all the tributaries except Furnace Run, Brandywine Creek, and Langes Run. The number of fecal coliform counts per 100 milliliters of sample was high throughout the study area and ranged from 38 to 1,200,000. Concentrations of all metals and nonmetals investigated by means of analysis of bed material were not anomalously high. (USGS)
W86-02389

SELECTED HYDROLOGIC DATA FOR THE SOUTH PLATTE RIVER THROUGH DENVER, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
N. E. Spahr, S. R. Blakely, and S. E. Hammond.
Available from OFSS, USGS, Box 25425, Lakewood, Co 80225. USGS Open-File Report 84-703, 1985. 225 p, 5 fig, 24 tab.

Descriptors: *Waste assimilative capacity, Reaeration, Traveltime, Water quality, *South Platte River, Denver, *Colorado, Water pollution sources, Urban hydrology.

The U.S. Geological Survey, in cooperation with the cities of Littleton and Englewood, Colorado, studied the effects of the discharge of treated effluent from the Bi-City Waste Water Treatment Plant on low-flow conditions of the South Platte River. An 18-mile reach of the South Platte River, beginning below Chatfield Reservoir, through the Denver metropolitan area was studied. Chatfield Reservoir was used to regulate the flow of the South Platte River on four occasions between October 1982 and January 1984. Each flow-regulation period was used to achieve a stable, low-flow condition. Data collection during low flow allowed for the study of waste assimilation during both warm- and cold-water conditions. Water quality, streamflow, channel geometry, traveltime, mixing-zone, reaeration, and benthic-oxygen demand data were collected at selected instream, tributary, and effluent sites. This report presents data collected during four periods of low flow along the South Platte River. (USGS)
W86-02391

EFFECTS OF STORMWATER RUNOFF ON AN URBAN LAKE, LAKE ELLYN AT GLEN ELLYN, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
R. G. Striegl.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-603, 1985. 19 p, 7 fig, 9 tab, 20 ref.

Descriptors: *Urban hydrology, *Storm runoff, *Detention storage, Trace metals, Sediment control, Limnology, Trap efficiency, *Runoff detention, *Illinois, Lake Ellyn.

Detention of urban runoff was observed to have physical, chemical, and biological effects on a small lake located near Chicago, Illinois. Accumulated bottom sediments reduce lake storage and have comparatively high concentrations of metals and organic compounds. Concentrations of many constituents dissolved in the lake water are seasonally cyclic, with annual concentration peaks occurring during the winter. Maintenance of desirable benthic invertebrate and fish communities, and development of undesirable phytoplankton blooms appear to be inhibited by sediments deposited on the lake bottom and suspended in the lake water. (USGS)
W86-02392

ALDICARB-PESTICIDE CONTAMINATION OF GROUND WATER IN EASTERN SUFFOLK COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
J. Soren, and W. G. Stelz.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4251, 1984. 34 p, 7 fig, 4 tab, 26 ref.

Descriptors: *Water pollution sources, Groundwater quality, Geologic formations, Aquifers, *Hydrogeology, *Groundwater, Water pollution, *Pesticides, *New York, *Groundwater pollution, *Long Island, Eastern Suffolk County, *Aldicarb pesticide.

Aldicarb, a toxic oxime-carbamate pesticide that was believed incapable of reaching ground water, was used in potato-farming areas of eastern Suffolk County, New York during 1975-80. In 1979, aldicarb was found in substantial concentrations in ground water throughout the area. The New York State Department of Health set a limit of 7 micrograms per liter for aldicarb in drinking water. Extensive ground-water sampling into 1980 showed widespread contamination ranging from small amounts to as much as 515 micrograms per liter. In 1980, the U.S. Environmental Protection Agency banned the use of aldicarb on Long Island at the manufacturer's request. A 1982 sampling study found aldicarb to have penetrated to about 40 feet below the water table in concentrations ranging from below detection limit to 239 micrograms per liter. Despite reputed toxicity, no instance of aldicarb poisoning on Long Island has been documented. The excessive aldicarb concentrations in the ground water of eastern Long Island may persist for decades; the duration has not been precisely determined and remains under investigation. (USGS)
W86-02394

VOLATILE TRACE-ELEMENT CONCENTRATIONS IN SNOWMELT CONTRIBUTIONS TO STREAMS MONITORED BY HYDROLOGIC BENCH MARK NETWORK STATIONS IN THE CONTERMINOUS UNITED STATES WHERE AVERAGE ANNUAL SNOWFALL EXCEEDS 12 INCHES,
Geological Survey, Bismarck, ND. Water Resources Div.
R. L. Houghton, and L. Schimke.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4104, 1985. 19 p, 5 fig, 4 tab, 28 ref.

Descriptors: *Snowmelt, *Stream pollution, *Trace metals, *Chemistry of precipitation, *United States, *Hydrologic Benchmark Network.

Water-quality data collected for more than 10 years at 35 Hydrologic Bench-Mark Network stream stations in the snowbelt of the conterminous United States where average annual snowfall exceeds 12 inches were evaluated for evidence of trace-element enrichments during initial springtime snowmelt. Data for at least 1 initial snowmelt period are available at only 11 of these stations. Snowmelt enrichments in the concentrations of volatile trace elements, such as mercury, molybdenum, and selenium, ranged from 0 to 100 percent at stations in North Dakota and Montana. Enrichments in volatile trace-element concentrations were accompanied by pH decreases; and, therefore, pH decreases during snowmelt at other sites may indicate enrichment of volatile trace elements. Although enrichments of some of these trace elements exceeded 90 times their mean concentrations during nonsnowmelt periods, concentrations did not exceed drinking-water standards. However, concentrations of mercury in laboratory-simulated snowmelt exceeded drinking-water standards. (USGS)
W86-02397

DISTRIBUTION AND TRANSPORT OF TRACE SUBSTANCES IN THE SCHUYLKILL RIVER BASIN FROM BERNE TO PHILADELPHIA, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
J. K. Stamer, T. H. Yorke, and G. L. Pederson.
Available from Distribution Branch, USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Water-Supply Paper 2256-A, 1985. 45 p, 33 fig, 12 tab, 40 ref.

Descriptors: *Bottom sediments, *Trace elements, *Pesticide residues, *Probability distribution, Water quality standards, *Pennsylvania, *Schuylkill River, *Water pollution sources.

From October 1978 to March 1981, the U.S. Geological Survey assessed quality of Schuylkill River from Berne to the Fairmount Dam at Philadelphia, Pennsylvania. The assessment focused on the distribution and transport of trace metals and organic substances. In general, concentrations of trace metals and organic trace substances in the bottom sediments exceeded the background concentrations in the study area, and were greater in the main stem of the Schuylkill River than in its tributaries. Concentrations of most trace metals were lowest at Berne and highest in the urban-industrial Reading area. Concentrations generally decreased from Reading downstream to Philadelphia. Concentrations of chlordane, DDT and its metabolites, and dieldrin generally increased from Berne to Philadelphia, paralleling the increase in urban land use from Berne to Philadelphia. Transport of trace metals in the Schuylkill River is closely related to suspended-sediment transport. About 71 percent of the average annual transport of trace metals is in particular material. The frequency at which concentrations of copper, lead, and zinc in the Schuylkill River at Manayunk at Philadelphia are estimated to exceed domestic water-supply criteria of the U.S. Environmental Protection Agency is less than 1 percent of the time. (USGS)
W86-02410

5C. Effects Of Pollution

RELATIVE SENSITIVITY OF SEABIRD POPULATIONS IN ALASKA TO OIL POLLUTION,
Bureau of Land Management, Anchorage, AK. Alaska Outer Continental Shelf Office.
D. J. Hansen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142091, Price codes: A02 in paper copy, A01 in microfiche. Technical Paper No3, August 1981, 15 p, 2 fig, 4 tab, 13 ref, append.

Descriptors: *Oil pollution, *Waterfowl, *Water birds, *Alaska, *Sensitivity analysis, Water pollution effects, Birds, Arctic Polar regions, Ecological effects, Oil spills.

The oil vulnerability index (OVI) developed by King and Sanger (1979) was used to identify sensitive species of birds in Alaska that could be affected by oil pollution. Many of the most common seabirds in Alaska and species endemic to the Bering Sea or the North Pacific are highly sensitive (a score of 70 or greater OVI) to oil pollution. The southern Bering, northern Bering, and the Chukchi Sea regions have over 80% of their major seabird colony populations rated highly sensitive. Within the Gulf of Alaska, the northwestern region and southwestern region have substantially larger populations of sensitive birds than the northeastern region. In general offshore oil and gas development in the Bering Sea poses a greater risk to seabird and waterfowl populations than would oil development in the Arctic Ocean or in the Gulf of Alaska. Oil and gas activities within the major foraging habitat of vulnerable populations in the Bering Sea represents the greatest concern to seabirds in Alaska. For most endemic waterfowl populations, the Yukon-Kuskokwim Delta represents the most important or critical habitat in Alaska. (Geiger-PTT)
W86-01975

PARAHO ENVIRONMENTAL DATA: BIBLIOGRAPHY,
Development Engineering, Inc., Rifle, CO.
For primary bibliographic entry see Field 10C.
W86-01983

TYPES OF POTENTIAL EFFECTS OF OFFSHORE OIL AND GAS DEVELOPMENT ON MARINE MAMMALS AND ENDANGERED SPECIES OF NORTHERN BERING, CHUKCHI, AND BEAUFORT SEAS,
Bureau of Land Management, Anchorage, AK. Alaska Outer Continental Shelf Office.
C. J. Cowles, D. J. Hansen, and J. D. Hubbard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-146142, Price codes: A02 in paper copy, A01 in microfiche. Technical Paper No9, December 1981. 23 p, 75 ref.

Descriptors: *Mammals, *Marine animals, *Offshore platforms, *Oil pollution, *Oil spills, Seals, Whales, Arctic, Polar regions, Marine plants, Ocean dumping, Water pollution effects, Natural gas, Water birds.

Direct effects of spilled oil to non-endangered marine mammals would vary depending on population density, physiological status, season, meteorological conditions, spill characteristics, duration of exposure and other factors. For many of the species occurring in Alaskan arctic areas, long-term, chronic, and direct or indirect effects associated with oil and gas development are of greater concern than the probability of widespread direct affects on seal populations. One possible result of low-level or chronic pollution would be to contribute to physiological stress on marine populations which may be at or near carrying capacity. Indirect effects of oil pollution on marine mammals would be those associated with changes in availability or suitability of various food sources or essential habitat factors. Mammalian species such as bearded seal or walrus may be most likely to show tropic-related effects in a specific locale since they rely on relatively sedentary benthic food sources. Shock waves and noise disturbance associated with offshore oil and gas development may alter the behavior of marine mammals. Other factors which may directly affect marine mammals include shoreline alteration, facility siting, dredging and filling, and secondary development. Potential factors affecting endangered cetaceans include direct and indirect oil and gas pollution effects, noise and disturbance effects and other factors such as marine disposal of drilling muds, formation waters, and cooling waters, shoreline alterations, and airborne noise. (Geiger-PTT)
W86-01986

ECOLOGICAL EFFECTS OF ACID PRECIPITATION,
Sigma Research, Inc., Richland, WA.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-903148, Price codes: A05 in paper copy, A01 in microfiche. Proceedings of a Workshop held March 4-6, 1981, Atlanta, Georgia. EPRI-EA-2273, February 1982. 98 p, append. EPRI-WA 80-180.

Descriptors: *Acid rain, *Ecological effects, *Water pollution effects, *Air pollution, *Conferences, Acidic water, Ecosystems, Environmental

effects, Vegetation effects, Aquatic animals, Lime, Forest watersheds, Crop production, Fate of pollutants, Symposium.

The three-day workshop on Ecological Effects of Acid Precipitation was convened in Atlanta, Georgia, on March 4, 1981. This undertaking, sponsored jointly by the US Environmental Protection Agency (EPA) and the Electric Power Research Institute (EPRI), constituted the initial step in a series of planned, interactive efforts to enhance cooperation between individuals and agencies involved in acid precipitation research. The intent of the co-sponsors was to provide a forum for exchange concerning research directions being pursued by industry and government and to explore the need for coordination and integration of US studies - especially the ecosystem effects studies of EPRI and EPA. Approximately 85 active researchers, managers, and planners attended the workshop. These invited participants were drawn primarily from the fields of aquatic and terrestrial ecosystem research and included representatives from Canada, Norway, Sweden, and the United Kingdom. The workshop included presentations of program descriptions, a limited set of technical research efforts, and summaries of non-US programs in ecosystems studies. It culminated in a series of working group sessions that examined issues in aquatic systems, agricultural systems, natural terrestrial systems, and an overview of effects. Each working group considered outstanding research issues and identified critical areas where coordination and integration of research efforts could accelerate our understanding of the impacts of acid precipitation. (Author)
W86-02039

ENVIRONMENTAL AND ENGINEERING ASPECTS RELATED TO THE RESTORATION OF A FERROUS SULFATE (COPPERAS) WASTE DISPOSAL SITE,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 5E.
W86-02117

WATER CHLORINATION PROGRAMS AT ONTARIO HYDRO FOSSIL-FIRED GENERATING STATIONS,
Ontario Hydro, Toronto.
For primary bibliographic entry see Field 5B.
W86-02160

PUBLIC HEALTH ASPECTS OF WATER SUPPLIES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
A. W. Hoadley.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 17-36, 1 tab, 72 ref.

Descriptors: *Water treatment, *Drinking water, *Public health aspects, Potable water, Trace metals, Metals, Water analysis, Bacterial analysis, Salmonella, Shigella, Carcinogens.

Engineers involved in water supply must understand potential threats to the health of consumers, standards of quality with which to judge safety, and techniques for evaluating quality. Towards this end, several aspects of public health, related to water supplies are discussed. The most common waterborne infectious disease has been acute gastrointestinal illness. The waterborne bacterial pathogens Salmonella, Shigella, Escherichia coli, Yersinia enterocolitica, and Pseudomonas aeruginosa have all been implicated in major outbreaks of disease. The most common of the waterborne protozoan pathogens is Giardia lamblia. While outbreaks of waterborne Entamoeba hisolytica were reported in the United States prior to 1970, none have been reported since then. Viral diseases, such as hepatitis, are very serious matters with regard to water treatment, because very small numbers of viral particles appear to be capable of causing infection in man. The importance of trace metals in cardiovascular diseases and psychiatric disorders is discussed. Finally, the relationship between known carcinogens in drinking water supplies, and the incidence of various types of cancer is discussed. It appears that asbestos fibers, polynuclear aromatic hydrocarbons, chloroform, and carbon tetrachloride contamination in water has been related to cancers of the urinary organs and the gastrointestinal tract. (Halterman-PTT)
W86-02190

PCB'S: HUMAN AND ENVIRONMENTAL HAZARDS,
For primary bibliographic entry see Field 5B.
W86-02248

PCB PROBLEM: AN OVERVIEW,
Michigan State Univ., East Lansing.
For primary bibliographic entry see Field 5B.
W86-02249

OVERVIEW OF THE SCIENTIFIC BASIS FOR CONCERN WITH POLYCHLORINATED BIPHENYLS IN THE GREAT LAKES,
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
For primary bibliographic entry see Field 5B.
W86-02250

ENVIRONMENTALIST'S VIEW OF THE PCBS IN THE GREAT LAKES,
Michigan United Conservation Clubs, Lansing.
For primary bibliographic entry see Field 5B.
W86-02252

EDIBLE TISSUE SAMPLING FOR FISH CONTAMINANT ANALYSIS,
Michigan Dept. of Natural Resources, Lansing. Surface Water Quality Div.
For primary bibliographic entry see Field 5B.
W86-02253

ANALYSIS OF PCBS USING SPECIFIC ISOMER HIGH RESOLUTION CAPILLARY GAS CHROMATOGRAPHY,
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5A.
W86-02254

ECONOMIC IMPACTS OF PCB REGULATION IN FOOD FISH,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
D. R. Talhelm.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 409-422, 1 fig, 3 tab, 3 ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish.

Following the Food and Drug Administration's (FDA) lowering of the allowable polychlorinated biphenyl (PCB) levels from 5 to 2 mg/kg in the edible portion of fish and shellfish, the National Fisheries Institute claimed that a $7-10 million per year food loss would result. A hearing addressing this issue was presented with data (from the National Marine Fisheries Service) on a large variety of commerically important fish, including whitefish, trout, carp, catfish, striped bass, bluefish, mackerel and lobster. The largest food loss would result from the lobster industry, estimated at $10 million. The total loss for all fish was estimated to be $14 million. The National Fisheries Institute, however, estimated the food loss to be $24 million. The hearing examiner found that the loss would be $13.5 million. However, several mistakes were apparently made, which resulted in errors within several fish categories. However, the total loss figures were similar to the original estimates of the FDA. (Halterman-PTT)
W86-02256

5D. Waste Treatment Processes

ACID MINE DRAINAGE: CONTROL AND ABATEMENT RESEARCH,
Bureau of Mines, Pittsburgh, PA. Pittsburgh Research Center.
A. G. Kim, B. S. Heisey, R. L. Kleinmann, and M. Deul.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-140616, Price codes: A02 in paper copy, A01 in microfiche. Report IC/8905, 1982, 22 p, 16 fig, 3 tab, 28 ref.

Descriptors: *Wastewater treatment, *Water quality control, *Acid mine drainage, *Coal mines, Pyrite, Oxidation, Sulfuric acid, Thiobacillus ferrooxidans, Drainage, Neutralization, Lime, Limestone, Sludge, Surfactants, Mine wastes, Spoil banks.

Acid drainage from coal mines and refuse piles results from oxidation of pyrite to form sulfuric acid. As pH decreases, the pyrite-oxidizing activity of Thiobacillus ferrooxidans is promoted, further increasing the pH. The Bureau of Mines is conducting research to mitigate the impact of acid on streams and aquifers. Mine sealing by flooding can exclude oxygen, eliminating pyrite oxidation. However, long-term sealing has often failed in mines above drainage. Research on mine sealing includes studies on more efficient and less expensive seals, pneumatic stowing of limestone as a seal, outcrop barrier stability, relief wells, and oxygen diffusion in coal refuse piles. Developments in treatment of acid mine drainage before discharge into streams include a limestone neutralization process which produces a denser sludge, the effect of activated carbon catalyst on particles, and a low-cost treatment system for small acid-contaminated streams using artificial sphagnum moss and limestone rubble. Methods for at-source control of acid mine drainage currently under investigation are bactericides to control limestone treatment of freshly exposed pyrite, placement of sumps and pumping systems, and control of groundwater entering mines. (Cassar-PTT)
W86-01978

FEEDWATER CLEANUP FOR COMBINED ELECTROLYSIS CATALYTIC EXCHANGE,
Monsanto Research Corp., Miamisburg, OH.
J. E. Lentz, J. Sienkiewics, and R. E. Ellis.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-019838, Price codes: A02 in paper copy, A01 in microfiche. Report MMM-2970; UC-70, Final Report. July 30, 1982. 13 p, 1 fig, 7 tab. DE-AC04-76-DP00053.

Descriptors: *Wastewater treatment, *Organic compounds, *Oily water, Ion exchange, Activated carbon, Adsorption, Electrolysis catalytic exchange system, *Tritium, *Radioactive wastes, Tritiated water.

A treatment process was developed for removing oil from tritiated wastewater from the combined electrolysis catalytic exchange system at the Mound Facility, Miamisburg, Ohio. The pilot scale process comprised skimming of the oily layer, filtering to remove particulates, absorbing soluble organic material in three traps filled with material such as activated carbon, filtering to remove carbon particles, and removing inorganic contaminates with ion exchange resin. If the treated water was not satisfactory for feeding into the combined electrolysis catalytic exchange system, it was recycled for further treatment. Some inconsistencies in organic removal were possibly a result of channeling in the carbon beds. High flow rates tended to produce better organic removal. Materials tested in the traps were Witco activated carbons, Grades 940, 950, and 965, and three types of Amberlite ion exchange resins, XAD-7, XAD-4, and IRA-938. The ion exchange resins actually added organic matter to the water being treated. Of the activated carbons, Witco 950 was most effective in reducing organic levels. (Cassar-PTT)
W86-01980

PHYSICOCHEMICAL TREATMENT METHODS FOR OIL SHALE WASTEWATER: EVALUATION AS AIDS TO BIOOXIDATION,
California Univ., Berkeley. Lawrence Berkeley Lab.
B. M. Jones, R. H. Sakaji, and C. G. Daughton.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-020295, Price codes: A02 in paper copy, A01 in microfiche. Report LBL-14666, July 1982. 17 p, 8 fig, 43 ref. DE-AC03-76SF00098.

Descriptors: *Biological wastewater treatment, *Physicochemical treatment, *Biological oxidation, *Oxidation, *Oil waste, Activated carbon, Organic carbon, Wastewater treatment, Ozonation, Wastewater oxidation, Ultraviolet radiation, Mineralization, Sorption.

Biological treatment is usually effective for the mineralization of only one-half of the organic carbon present in retort waters. Several physicochemical treatment methods including sorption and chemical oxidation were evaluated for their ability to complement or enhance biooxidation. The use of spent shale or powdered activated carbon (PAC) effected preferential sorption of the less polar, biorefractory organic compounds from retort water. However, the concurrent application of these sorbents with biooxidation did no promote a synergistic removal. The construction and application of a pilot-scale adiabatic stainless steel and beaded-glass steam stripper for removal of ammonia, hydrogen sulfide and carbon dioxide from oil shale process wastewaters is discussed; emphasis is placed on the benefits steam stripping would accord biooxidation. Ultraviolet radiation had no significant effect on the biorefractory organic solutes in retort water. Extensive ozonation structurally altered 14% of the recalcitrant dissolved organic carbon. Ozonation mediated by ultraviolet radiation had a synergistic effect. Potent chemical oxidation was incapable of effecting sufficient structural alteration of the biorefractory compounds to encourage renewed biooxidation. This implies that oxidative enzyme systems may also be incapable of promoting further alteration or mineralization of these recalcitrant solutes. (Geiger-PTT)
W86-01982

TECHNICAL GUIDE ON BIOLOGICAL NUTRIENT REMOVAL: THE PHOREDOX PROCESS,
National Inst. for Water Research, Pretoria (South Africa).
M. J. N. Simpkins, and A. Gerber.
1981. 20 p, 13 fig, 5 tab, 27 ref.

Descriptors: *Wastewater treatment, *Nutrient removal, Phoredox process, Phosphates, Nitrates, Nitrogen, Denitrification, Biological wastewater treatment, Design criteria, Pilot plants, Anaerobic digestion, Aerobic digestion, Clarifiers, Sludge.

This guide, intended as a help in design and operation of the Phoredox process, was developed from data obtained at a Pretoria pilot plant operating on domestic sewage. The Phoredox process is a five-stage process designed to remove nitrogen and phosphorus by biological means. These stages are as follows: anaerobic--denitrification and phosphate release; primary anoxic--additional denitrification of nitrates; primary aeration--oxidation of biodegradable nitrogen and carbonaceous matter; secondary anoxic and aerated--denitrification of nitrates formed in the previous stage; and clarifier--separation of phosphate-containing solids. A pilot plant experience is detailed. Phosphate removal efficiencies were 78% and 68% for settled sewage feed and raw sewage feed, respectively. Effluent nitrate and phosphate concentrations regularly were higher on weekends, coinciding with the drop in COD. Several critical points in design and operation are emphasized. Aeration must be uniform so that no anaerobic zones exist. The anoxic retention time can be increased during periods of low COD. Excess oxygen uptake in the aeration phases or from the atmosphere should be avoided prior to entering the anoxic phases. (Cassar-PTT)
W86-01998

AQUACULTURE SYSTEMS FOR WASTEWATER TREATMENT: SEMINAR PROCEEDINGS AND ENGINEERING ASSESSMENT,
Environmental Protection Agency, Washington, DC. Municipal Construction Div.
Proceedings held September 11-12, 1979, University of California-Davis. Report EPA 430/9-80-006, September 1979, MCD-67. 485 p.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, *Fish, Bilogical wastewater treatment, Tertiary wastewater treatment, Lagoons, Wastewater lagoons, Wetlands, Water hyacinth, Nutrient removal.

Papers on wastewater aquaculture are divided into several categories: overview, use of wetlands (creation of new wetlands, use of existing wetlands, and use of cypress domes), aquatic plant systems (mainly water hyacinth), combined systems with aquatic pants and fish or shellfish, and economic and energy aspects. (Cassar-PTT)
W86-02047

ENGINEERING ASSESSMENT OF AQUACULTURE SYSTEMS FOR WASTEWATER TREATMENT: AN OVERVIEW,
Cold Regions Research and Engineering Lab., Hanover, NH.
S. Reed, R. Bastian, and W. Jewell.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 1-12.

Descriptors: *Wastewater treatment, *Aquaculture, Wetlands, Aquatic plants, Fish, Ponds, Stabilization ponds, Water hyacinth, Biological wastewater treatment.

Aquaculture technology was evaluated for its suitability for municipal wastewater treatment. Artificially constructed wetlands show promise of general application. Water hyacinth systems are ready for routine use in municipal wastewater treatment in climates where the plants grow naturally. The possibility of using more cold-tolerant plants should be investigated. In combined systems finfish effectively participate in the treatment process, removing suspended solids in final polishing. Combined systems cannot presently be optimized for both protein/biomass production and wastewater treatment. Although information on operating fish culture units in stabilization ponds is available, routine design for the purpose of wastewater treatment is not yet possible. (Cassar-PTT)
W86-02048

FEDERAL ROLE AND INTEREST BY EPA'S CONSTRUCTION GRANTS PROGRAM IN AQUACULTURE SYSTEMS FOR MUNICIPAL WASTEWATER TREATMENT,
Environmental Protection Agency, Washington, DC.
J. N. Smith, and R. K. Bastian.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 29-33, 6 ref.

Descriptors: *Wastewater treatment, *Aquaculture, Federal jurisdiction, Construction, Grants Program, Innovative/alternative technology.

The subject of water pollution control and wastewater treatment can be seen as a problem of biology rather than simply one of engineering. The scientific basis for treating and the reuse/recycling of wastewater should give greater emphasis to ecology and the management of natural biological systems. Neither the technological problems of designing biological systems nor the political and institutional constraints facing their implementation should prevent the increased future use of aquaculture systems for wastewater treatment. Where these systems can be made to work they should offer effective solutions to the need for cost-effective, environmentally acceptable, and energy efficient wastewater treatment and recycle/reuse practices. In order to assist in encouraging greater use of these aquaculture systems for wastewater treatment, we need to make sure that the results of past and ongoing research efforts are effectively applied to innovative/alternative technology projects funded through the EPA Construction Grants Program. (Author)
W86-02049

USE OF AQUATIC PLANTS AND ANIMALS FOR THE TREATMENT OF WASTEWATER: AN OVERVIEW,
California Univ., Davis. Dept. of Civil Engineering.
G. Tchobanoglous, R. Stowell, R. Ludwig, J. Colt, and A. Knight.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 35-55, 3 fig, 6 tab, 16 ref.

Descriptors: *Wastewater treatment, *Aquaculture, Aquatic plants, Fish, Biological wastewater treatment, Algae, Zooplankton, Shellfish, Crustaceans, Design criteria.

Aquatic systems employing plants and animals have been proposed as alternatives to conventional wastewater treatment systems. The fundamental difference between conventional and aquatic systems is that in the former, wastewater is treated rapidly in highly managed environments, whereas in the latter, treatment occurs at a comparatively slow rate in essentially unmanaged natural environments. The consequences of this difference are (1) conventional systems require more construction and mechanization but less land than aquatic systems, and (2) conventional processes are subject to greater operational control and less environmental influence than aquatic processes. The major stimulus for further research into the fundamentals, design, and management of aquatic systems is the potential for reducing the construction and operation and maintenance costs for wastewater treatment. The general concept involved in the design and use of aquatic systems are presented and the implications are discussed in this overview. (Author)
W86-02050

WETLANDS CREATION FOR HABITAT AND TREATMENT - AT MT. VIEW SANITARY DISTRICT, CA.,
Mountain View Sanitary District, Martinez, CA.
F. C. Demgen.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 61-73, 4 fig, 2 tab, 12 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Wetlands, Aquatic habitats, Nutrient removal, Nitrogen, Phosphorus, Mt. View, California, Habitats, Aquatic plants, Vegetation, Algae, Animals, Invertebrates.

The Mt. View (California) Sanitary District's wetlands creation project on low lying reclaimed tidal lands, uses treated sewage effluent as a freshwater source. The wetlands system covers 20.3 acres and consists of five interconnected areas with tributary edge habitat. Detention time is 5 days at design capacity. The ecosystem has been balanced and healthy. The habitat supports 72 species of plants, 21 species of animals, 90 species of birds, and 34 species of aquatic invertebrates. Natural predators control mosquito breeding. No avian botulism or odors are evident because good water circulation is maintained. Redwood bark floats have been added to provide supplementary habitat for aquatic invertebrates. Water quality parameters are as follows: (1) dissolved oxygen, 1 mg/liter to supersaturation, normally above 5 mg/liter, (2) BOD, varies seasonally, usually less than loading levels and consists of algae and other organisms, (3) suspended solids, usually reduced in winter but not in summer, (4) nitrates, >90% removal consistently, (5) ammonia and organic nitrogen, about 60% removal, and (6) phosphates, 37-53% removal.

W86-02051

CYPRESS WETLANDS FOR TERTIARY TREATMENT,
Boyle Engineering Corp., Orlando, FL.
W. R. Fritz, and S. C. Helle.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 75-81, 7 fig. ENV76-23276.

Descriptors: *Wastewater treatment, *Wetlands, *Cypress, Florida, Nutrient removal, Biological wastewater treatment, Tertiary wastewater treatment, Swamps.

Cypress domes (shallow, saucer-shaped depressions receiving drainage water) are technically feasible as a tertiary wastewater treatment method. Three concepts are possible. (1) The natural dome needs little modification. Treated wastewater, applied to the center of the dome percolates to the groundwater, losing contaminants on the way. (2) The isolated dome needs an earth dike around the perimeter to keep out storm runoff and retain wastewater. (3) The flow through system operates as a sheet flow through the cypress strand with purification en route to a downstream waterway. Tests show 98% total nitrogen removal and 97% total phosphorus removal. Cypress strands have economic advantages over the other methods because they can process a larger volume than the domes. Bacterial and viral contamination of the groundwater do not appear to be a problem if effluent is sufficiently chlorinated and if all short-circuits to the groundwater are avoided. Areas suitable for municipal treatment must have the following: sufficient capacity, low failure rates, flood and natural disaster resistance, adequate sunshine, electricity for pumps, and a sufficient safety factor. (Cassar-PTT)
W86-02052

DRUMMOND PROJECT - APPLYING LAGOON SEWAGE EFFLUENT TO A BOG: AN OPERATIONAL TRIAL,
Geological Survey, Ithaca, NY.
W. M. Kappel.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Poceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430-/9-80-006, September 1979. MCD-67. p 83-90.

Descriptors: *Wastewater treatment, *Wetlands, *Bogs, Shagnum, Drummond, Wisconsin, Biological wastewater treatment, Lagoons.

The Drummond Project (Wisconsin) is a multiresource continuing study of a sphagnum bog and its response to the application of sewage effluent. The intent of the project is to understand the dynamics of this type of wetland as well as determining whether this type of wetland can be used to effectively treat and assimilate residential sewage effluent. Up to this time, little was known of the dynamics or treatment capabilities of sphaghnum peat wetland. (Author)
W86-02053

EFFECTIVENESS OF A WETLAND IN EASTERN MASSACHUSETTS IN IMPROVEMENT OF MUNICIPAL WASTEWATER,
IEP, Inc., Wayland, MA.
D. A. Yonika.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 91-100, 4 fig, 3 tab.

Descriptors: *Wastewater treatment, *Wetlands, Biological wastewater treatment, Tertiary wastewater treatment, Concord, Massachusetts, Marshes, Nutrient removal, Nitrogen removal, Phosphorus removal.

The Concord, Massachusetts, sewage treatment plant discharges secondary effluent to a 48-acre deep marsh. The wetlands functions as two units: a 6-acre shallow marsh/shrub swamp and the deep marsh. Retention time is 57 days. Final discharge is into the Concord River. Concentrations of substances (in mg/liter) in effluent and in discharge to the river, respectively, were as follows: ammonia N, 8.0 and 0.15; nitrate-N, 3.1 and 0.47; nitrite nitrogen, 0.019 and 0.010; Kjeldahl N, 10.0 and 0.77; total phosphorus, 2.1 and 0.17; orthophosphate, 1.6 and 0.10; and BOD, 38.2 and 2.3. Average annual removal efficiencies ranged from 20% for nitrate-N to 67% for BOD. Nitrite-N was released from the system. Removal efficiency varied seasonally. The BOD uptake was higher on an annual basis in the shallow area (20.8 pounds per acre per day). The shallow area was also more efficient than the deep marsh in removing phosphorus. Ammonia-N removal rates were higher in the deep marsh; nitrate-N removal rates were higher in the shallow area. (Cassar-PTT)
W86-02054

WETLAND TERTIARY TREATMENT AT HOUGHTON LAKE, MICHIGAN,
Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.
R. H. Kadlec.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 101-139, 13 fig, 11 tab, 43 ref.

Descriptors: *Wastewater treatment, *Wetlands, Biological wastewater treatment, Nutrient removal, Nitrogen removal, Phosphorus removal, Tertiary wastewater treatment, Environmental effects, Aquatic habitats, Habitats, Plants, Animals, Houghton, Michigan.

Secondary wastewater effluent was discharged to a 7 sq km peatland near Houghton, Michigan, for five consecutive summers. All nitrogen and phosphorus was stored or removed within a 5-acre area at a discharge rate of 100,000 gal/day and within a 50-acre area at a discharge rate of 1 million gal/day. Chloride and other inactive dissolved ions moved through the wetland with very little change. pH, higher in the discharge, dropped rapidly to background levels (slightly acid) as the discharge traveled across the wetland. Conductivity also dropped to background levels. Suspended solids were deposited close to the discharge area. Erosion, plant mortality, odor, and effects on animals and birds were nonexistent. The only visual effects were greener plants and slightly deeper water near the discharge. Coliforms and viruses appeared at equal levels in the discharge and the wetland. (Cassar-PTT)
W86-02055

ENGINEERING, ENERGY AND EFFECTIVENESS FEATURES OF MICHIGAN WETLAND TERTIARY WASTEWATER TREATMENT SYSTEMS,
Williams and Works, Grand Rapids, MI.
T. C. Williams, and J. C. Sutherland.
IN: Acquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979, MCD-67. p 141-173, 12 fig, 3 tab, 15 ref.

Descriptors: *Wastewater treatment, *Wetlands, Biological wastewater treatment, Irrigation, Wastewater irrigation, Tertiary wastewater treatment, Houghton, Vermontville, Michigan, Phosphorus removal, Nitrogen removal, Spray irrigation, Energy, Capital costs.

Two markedly different Michigan wetlands are receiving pond stabilized secondary treated nonchlorinated wastewater. Both operations result in removal of 98%-100% of phosphorus through contact with reactive soils. At Vermontville, flood irrigation fields (11.5 acres) overgrown with volunteer wetland vegetation (mainly cattail) treat and dispose of wastewater princpally by slow seepage (4 inches-week) through phosphorus-absorbing clayey-silty glacial till. Occasional uncontrolled runoff of wetland surface waters releases phosphorus, BOD, and uspended solids in concentrations slightly above permitted limits. Seepage wetlands offer potential advantages compared to upland spray irrigation for small communities. Savings of 25% or greater on capital plus land costs can be expected for flow below 0.1 MGD average flows. Field maintenance may not be needed, and irrigation energy costs need be no higher than those for surface irrigation of uplands. At Houghton Lake natural state-owned wetlands (600 acres) treat and dispose of wastewater by overland flow across a reactive peat substrate. Construction and maintenance in 1978 involved negligible ecological impact. Construction was done in the dormant months between March and June. The wetland transmission and irrigation pipelines are strapped to a wooden walkway suspended 2.5 ft above the wetland on pole pilings anchored in clay. The cost of the wetland wastewater distribution system was $21.00/ft (1979 dollars). Irrigation electrical energy costs were approximately $7.21 in 1979. The wetland capital and land costs represent savings of approximately $1 million compared to upland irrigation. (Author)
W86-02056

ENGINEERING DESIGN DATA FOR SMALL VASCULAR AQUATIC PLANT WASTEWATER TREATMENT SYSTEMS,
National Space Technology Labs., NSTL Station, MS.
B. C. Wolverton.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 179-192, 3 fig, 4 tab, 12 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, Lagoons, Wastewater lagoons, Water hyacinth, Duckweed, Phenol, Biological wastewater treatment, Secondary wastewater.

A general background of the research findings of the National Aeronautics and Space Administration's Vascular Aquatic Plant Program using higher plants such as the water hyacinth (Eichhornia crassipes) and duckweed (Lemna sp. and Spirodela sp.) to treat domestic wastewater is presented. New data on a small two-cell lagoon system using only duckweed is included. Further laboratory experiments were conducted to correlate BOD removal with known wet masses of water hyacinths. The data from these experiments with domestic wastewater indicates that an average total BOD removal rate of 4.0 mg BOD/gram wet weight could be achieved with a seven day retention time. When a phenol solution is substituted for the wastewater, the average total BOD removal is 3.5 mg BOD/gram wet weight in seven days. This data along with the results of the previous field experiments, is used to develop design criteria for small domestic wastewater treatment systems servicing a maximum of 3000 people. The criteria for these systems addresses the problems of BOD reduction, total suspended solids reduction, odor control, and sludge accumulation. (Author)
W86-02057

DEVELOPMENT OF HYACINTH WASTEWATER TREATMENT SYSTEMS IN TEXAS,
Texas State Dept. of Health, Austin.
R. Dinges.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 193-231, 16 fig, 4 tab, 15 ref, 1 append.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, *Water hyacinth, Biological wastewater treatment, Nutrient removal, Nitrogen removal, Phosphorus removal, Algae, Texas, Hydraulic loading.

Plant-scale wastewater treatment by water hyacinth culture has been implemented in several Texas locations. Some general conclusions can be

drawn from these experiences. Sufficient design data is presently available for constructing hyacinth tretment facilities in warm climates. However, optimal design is necessary to minimize areas and costs for using this treatment system in greenhouses in temperate climates. The most critical consideration in culture basin design is hydraulic loading. A triangle-shaped basin is an ideal shape; two of these may be combined to form a rectangle for better land use. The primary pollutant removal mechanism in hyacinth treatment is removal of suspended particulates. Since hyacinth harvesting disrupts treatment, multiple culture basins should be used for alternate operation. Nitrogen management is a key factor in utilizing hyacinths for wastewater treatment or for biomass production. Stablilization ponds can be designed for effective nitrogen reduction. Hyacinth removes most remaining nitrogen in pond effluent, especially that in organic form such as algae. Effluent from a hyacinth treatment system can produce effluents with less than 10 mg/liter BOD and total suspended solids. (Cassar-PTT)
W86-02058

WATER HYACINTH ADVANCED WASTEWATER TREATMENT SYSTEM,
Coral Ridge Properties, FL.
D. Swett.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. p 233-255, 2 fig, 7 tab.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, *Water hyacinth, Advanced wastewater treatment, Lagoons, Coral Springs, Florida, Biological wastewater treatment.

A one-year field experiment at the 378,530 liters/day (100,000 gpd) level has demonstrated that a system of 5035 sq m (54,200 sq ft) of water hyacinth (Eichhornia crassipes) lagoons can provide advanced treatment to effluent from an activated sludge plant by achieving removal rates of 67% for total suspended solids, 98% for biochemical oxygen demand, 97% for total nitrogen and 79% for total phosphorus. Biomass produced by the system offers a potential for energy, fertilizer or fodder production. (Author)
W86-02059

WATER HYACINTH WASTEWATER TREATMENT SYSTEM AT WALT DISNEY WORLD,
Reedy Creek Utilities Co., Inc., Lake Buena Vista, FL.
A. P. Kruzic.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis, EPA 430/9-80-006, September 1979. MCD-67, p 257-271, 2 fig, 3 tab, 5 ref.

Descriptors: *Wastewater treatment, *Aquatic plants, Water hyacinth, Biological wastewater treatment, Walt Disney World, Florida.

A water hyacinth wastewater treatment system is being tested at Walt Disney World, Florida. Consisting of three 1/4-acre channels with piping, hydraulic control devices, and pumping equipment, it is designed to handle flows up to 200,000 gpd with a probable minimum of 50,000 gpd. The completely mobile harvesting system includes a front end loader, conveyor-chopper, and forage wagon. Although most components of the project are operating as planned, some problems have developed. For example, in using a backhoe to seed the hyacinths into the channels, much grass and dollarweed was also brought in. The unwanted plant species had to be removed. In treating primary effluent, dissolved oxygen concentrations are very low. Floating sludge and fly larvae exist in ponds which once supported a mosquitofish population. Testing of the system continues. (Cassar-PTT)
W86-02060

UTILIZATION OF WATER HYACINTHS FOR CONTROL OF NUTRIENTS IN DOMESTIC WASTEWATER -- LAKELAND, FLORIDA,
Dawkins and Associates, Inc., Orlando, FL.
E. A. Stewart.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 273-293, 8 fig, 1 tab, 8 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, Fish, Water hyacinth, Lakeland, Florida, Nutrient removal, Nitrogen removal, Phosphorus removal, Invertebrates, Mosquitoes, Biological wastewater treatment, Lagoons, Wastewater lagoons, Ponds.

A large (up to 13 mgd) water hyacinth treatment demonstration project in Lakeland, Florida, was based on nutrient removal requirements of 1.5 mg/liter total N and 0.4 mg/liter total P. The system consisted of three one-acre lagoons in series. Plant health and chlorophyll content declined from Pond 1 to Pond 3, with iron the limiting nutrient. Oxygen levels in the water were adequate to above saturated, rarely falling below 2 mg/liter in Pond 1, which was expected to have the lowest levels. pH changed from neutral to slightly alkaline. BOD and suspended solids were reduced somewhat. Nitrogen and phosphorus uptake were greater than expected for the crop density of 99 metric tons/ha. Water color and turbidity were noticeably reduced throughout the system. Dissolved solids decreased due to selective uptake of certain ions such as ferrous ion, calcium, and chloride. Coliform reduction was dramatic. The biological nature changed throughout the system. In Pond 1 hyacinths were large; macroinvertebrates were restricted to chironomid larvae, mosquito larvae, and a snail; two fish species were surviving well. In Pond 2 the hyacinths were smaller and suffered from chlorosis; the invertebrate and fish populations were diverse and numerous. In Pond 3 hyacinths were very chloratic; fish and invertebrates were even more diverse than in Pond 2. Designing the system for plant growth kinetics in cool weather allows for a safety margin. (Cassar-PTT)
W86-02061

SOME ECOLOGICAL LIMITS TO THE USE OF ALTERNATIVE SYSTEMS FOR WASTEWATER MANAGEMENT,
Michigan State Univ., East Lansing. Inst. of Water Research.
D. L. King.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 299-307, 14 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Lagoons, Ponds, Biological wastewater treatment, Algae, Cyanophyta, Fish, Nitrogen removal, Phosphorus remcval, Standards, Effluent standards, Ecosystems.

Biological, chemical, and physical factors interact to place limitations on the use of natural ecosystems for wastewater treatment. An understanding of these limits allows better design of treatment systems to fit individual environmental and wastewater conditions. At the Michigan State University Water Quality Management Facility expansion of the lagoon system was based on effluent tests which showed excellent BOD and coliform removal. However, BOD was underestimated by the 5-day test. Algae, spilling into the effluent, did not decompose within 5 days but became part of the BOD load further downstream. When suspended solid limits were placed on lagoon effluents, lagoon systems required revision to meet standards. Other natural factors to consider are seasonal variations and the lack of a natural mechanism to remove phosphorus on a long-term basis. The nutrient balance in wastewater is not suitable for pond biota, favoring growth of undesirable blue-green algae. The presence of fish which eat zooplankton also favors eventual dominance of blue-green algae and supression of macrophytes. Another limiting factor, toxic to fish, is the ammonia and high pH common in wastewater ponds. The strict water quality standards with respect to pathogens and other contaminants discourages use of wastewater aquaculture food products at this time. (Cassar-PTT)
W86-02062

UTILIZATION OF SILVER AND BIGHEAD CARP FOR WATER IMPROVEMENT,
Arkansas Game and Fish Commission, Lonoke.
S. Henderson.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979, MCD-67. p 309-350, 5 append.

Descriptors: *Wastewater treatment, *Aquaculture, *Fish, Benton, Arkansas, Water quality, Silver carp, Bighead carp, Carp, Lagoons, Wastewater lagoons, Biological wastewater treatment.

Filter feeding fish, the silver and bighead carp, were stocked in an existing lagoon treatment system in 1975-76 for a preliminary evaluation of the effect of the fish on water quality and the potential of this nutrient source for fish production. In a full-scale 6-cell, 24-acre facility at Benton, Arkansas, BOD removal was 96.4% and suspended solids removal was 86% during the first 8 months of the study. Detailed water quality monitoring results are given in the appendixes. With three months remaining in the growing season, the standing crop of fish in the four ponds containing fish was >22,777 kg, a total average production of 3344 kg/ha. Fish tissue and water samples were regularly analyzed for particular pathogens, metals, and pesticides. Only Staphylococcus bacteria, copper and mercury levels were above detection limits. Using the fish as fish meal would yield a gross return of $430-$575/ha/year; for direct human consumption, $3600-$4525/ha. (Cassar-PTT)
W86-02063

TREATED SEWAGE EFFLUENT AS A NUTRIENT SOURCE FOR MARINE POLYCULTURE,
Woods Hole Oceanographic Institution, MA.
J. H. Ryther.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979, MCD-67. p 351-375, 7 fig, 5 tab, 5 ref.

Descriptors: *Wastewater treatment, *Aquaculture, Fish, Shellfish, Oysters, Clams, Flounder, Lobsters, Biological wastewater treatment, Tertiary wastewater treatment, Seaweed, Algae, Nitrogren removal, Nutrients.

A biological tertiary sewage treatment-marine aquaculture system was developed and studied at the Woods Hole Oceanographic Institution. Secondary sewage effluent mixed with sea water was used to grow phytoplankton in continuous flow-through cultures. This product was fed to several varieties of shellfish in stacked trays. Uneaten food and wastes from the shellfish supported small invertebrates, in turn eaten by lobster and flounder stocked in the shellfish areas. Effluent from the shellfish tanks was passed through red algae grown in suspended culture to reduce nutrients further. Total nitrogen removal efficiency was 93.6%. (Cassar-PTT)
W86-02064

SOLAR AQUACELL SYSTEM FOR PRIMARY, SECONDARY OR ADVANCED TREATMENT OF WASTEWATERS,
Solar AquaSystems, Inc., Encinitas, CA.
W. C. Stewart, and S. A. Serfling.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1969. MCD-67. p 377-412, 6 fig, 3 tab, 44 ref.

Descriptors: *Wastewater treatment, *Solar energy, Solar AquaCell system, Biological wastewater treatment, Nutrient removal, Aquatic plants, Hercules, California, Lagoons, Wastewater

lagoons, Advanced wastewater treatment, Tertiary wastewater treatment, BioWeb substrates, Aeration, Anaerobic conditions, Primary wastewater treatment.

The Solar AquaCell process consists of a series of multicell lagoons, a diffused aeration system, high surface area fixed-film substrates as a biofilm habitat, aquatic macrophytes, greenhouse pond cover, and a solar heat exchange system to heat the water phase. Three AquaCell pond systems (anaerobic, facultative, and aerobic) each with high surface area biofilm devices, can be used in series to achieve primary, secondary and/or advanced treatment, respectively. The system designed for the city of Hercules, California, 1325 cu m per day of raw wastewater, is described. (Cassar-PTT)
W86-02065

RESOURCE RECOVERY FROM WASTEWATER AQUACULTURE,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
L. O. Bagnall.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979, MCD-67. p 421-439, 11 fig.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, Biological wastewater treatment.

Removal and recycling of the nutrients and other components in the wastewater aquaculture system are completed by harvesting, processing and utilizing the aquatic organisms in which the nutrients are collected. Aquatic species grown in wastewater have been experimentally used for food, feed, fiber, fertilizer, and energy. Some of the processes and products appear to be technologically and economically feasible on an operational scale. (Author)
W86-02066

ENERGY FROM WASTEWATER AQUACULTURE SYSTEMS,
Ecoenergetics, Inc., Vacaville, CA.
J. R. Benemann.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 441-458, 4 tab, 39 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Anaerobic digestion, *Aquatic plants, Energy, Biological wastewater treatment, Digestion, Methane, Biomass, Ponds.

Aquatic biomass produced in wastewater treatment ponds can be an energy source. The high moisture, high nutrient, and low lignocellulose content of most aquatic plants makes them ideal substrates for anaerobic digestion. Although little specific data is available, this reaction can be expected to proceed without significant difficulties and at rates comparable to those seen with sewage sludge. Studies are being conducted on two-phase reactors which separate the acid and methane bacterial cultures. Other technologies are gas recovery from landfills or anaerobic ponds and the anaerobic filter process using an expanded bed reactor. The possible fuel outputs for a secondary wastewater aquaculture system of 15 mgd are 6.0 MBTU/MG with energy conservation of 6.0 MBTU/MG. A tertiary treatment system would produce about 37.5 MBTU/MG of net fuel output and have an energy conservation potential of 13.5 MBTU/MG. (Cassar-PTT)
W86-02067

OVERVIEW OF THE LEGAL, POLITICAL, AND SOCIAL IMPLICATIONS OF WASTEWATER TREATMENT THROUGH AQUACULTURE,
Denver Research Inst., CO.
L. C. Lohman.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 459-474, 13 ref.

Descriptors: *Wastewater treatment, *Water law, *Aquaculture, *Political aspects, *Social aspects, Legal aspects, Public participation, California, Regulations, Federal jurisdiction, State jurisdiction, Legislation, Standards, Water rights, Water reuse, Attitudes.

The legal, political, and social elements involved in full-scale aquaculture for wastewater treatment are highlighted. Emphasis is on California, where several aquaculture projects are under development. On the Federal level many statutes, regulations, and agencies are concerned with wastewater aquaculture. The National Water Pollution Control Act and its amendments exert the most direct control over wastewater discharges. State law regarding water quality is largely derived from Federal law. The power of particular interest to proponents of wastewater aquaculture is the state control over rights to use water and obligations to protect all water users. Wastewater aquaculture can change the quantity and quality of water for downstream users. States generally exercise control over all aspects of wastewater treatment with special concern about effects on public health. Legal and political elements are closely entwined. Influences and policies affect decisions on new wastewater facilities. Many conflicts are possible. Society reacts to proposed projects as different interest groups, from individuals to large organizations. Acceptance of wastewater aquaculture by the public is easier if effluent meets standards and no nuisances are created. (Cassar-PTT)
W86-02068

ECONOMICS OF AQUATIC TREATMENT SYSTEMS,
Metcalf and Eddy, Inc., Sacramento, CA.
R. W. Crites.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 475-485, 11 tab, 20 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, *Fish, Biological wastewater treatment, Tertiary wastewater treatment, Lagoons, Wastewater lagoons, Wetlands, Water hyacinth, Nutrient removal, Advanced wastewater treatment, Oxidation ponds, Economic aspects, Wetlands, Energy, Land disposal.

Aquatic treatment systems, although still in the development stage in most areas, offer low-cost, low-energy solutions for wastewater treatment. For advanced secondary treatment (BOD and suspended solids, 10 mg/liter; no nutrient removal), combinations of oxidation ponds with water hyacinths or wetlands are cost effective compared at 1 mgd with land treatment or conventional treatment. For the lowest cost flowsheet examined, the land cost can reach $115,000/acre before the conventional activated sludge system becomes economically competitive. For advanced wastewater treatment (nitrogen, 3 mg/liter; phosphorus, 1 mg/liter), aquatic systems alone have not been developed technically to achieve the same standards. The aquatic processes can, however, be integrated with land treatment and oxidation ponds to achieve this high quality of effluent. In the cases studied, the combined equatic-land treatment systems were less expensive than land or conventional treatment at 1 and 10 mgd. As aquatic systems become further developed and demonstrated, the costs will become more firmly established. In addition, the economic benefits (such as from compost, fertilizer, soil conditioners, or biogas) may offset some of the costs of wastewater treatment in the future. (Author)
W86-02069

TOXIC AND HAZARDOUS WASTES,
Proceedings of the Sixteenth Mid-Atlantic Industrial Waste Conference, June 24-26, 1984. Technomic Publishing Co., Inc., Lancaster, PA. 1984. Edited by Michael D. LaGrega and David A. Long. 587 p.

Descriptors: *Hazardous materials, *Industrial wastes, *Groundwater pollution, *Waste-water treatment, *Waste disposal, Sludge disposal, Conferences, Groundwater management, Land disposal, Activated sludge, Heavy metals, Incineration, Recycling, Industrial wastewater, Landfills, Symposium.

This book is an outgrowth of the proceedings of the sixteenth Mid-Atlantic Industrial Waste Conference. The conferences are designed to provide a forum for interchange of new technical and nontechnical solutions for industrial pollution control problems of the region by allowing regulatory agencies, industrial agencies, universities, and consulting engineers to exchange information regarding their various activities. The sessions of the conference included: biological wastewater treatment, waste incineration and energy recovery, international research topics, regulatory compliance, recycle/reuse, heavy metal control, physical-chemical processes, sludge management, hazardous waste-site clean-up, and groundwater protection. This book is intended to provide a state-of-the-art synopsis of contemporary practice in the control of industrial, toxic, and hazardous wastes. (Geiger-PTT)
W86-02094

BIODETOXIFICATION OF HAZARDOUS WASTEWATERS WITH ACTIVATED ROTATING BIOLOGICAL CONTACTORS,
Memphis State Univ., TN. Dept. of Civil Engineering.
J. W. Smith, and L. W. Moore.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 15-28, 13 fig, 3 tab, 2 ref.

Descriptors: *Hazardous materials, *Organic wastes, *Biological wastewater treatment, *Wastewater treatment, *Organic pesticides, Chlorinated hydrocarbons, Halogenated pesticides, Copper, Leachates, Industrial wastewater, Industrial wastes, Activated sludge process, Aeration, Pesticides, Color, Hydrogen ion concentration.

A bench-scale rotating biological contactor (RBC) that was modified to include an aeration basin and final clarifier with sludge recycle to the fixed film media (ARBC) was tested on several hazardous organic wastes. The ARBC system was compared to a completely mixed activated sludge system with respect to treatability of pesticide formulation wastewater, and wastewaters containing dog food or Cu and synthetic leachates containing heptachlor, chlordane and endrin, or organic wastewaters high in color or pH. Results showed that ARBC systems achieved higher organic removal efficiencies than did activated sludge systems, and generally removed greater quantities of hazardous pollutants such as Cu and pesticides. About 95% of the heptachlor, chlordane and endrin were removed from wastewater by two ARBC systems operating in series. The ARBC system tolerated as high as 5 milligrams/liter soluble Cu, but long term exposure to such concentrations would probably interfere with treatment efficiency. The ARBC system exhibited greater removal efficiencies in the treatment of a strong, organic industrial waste than did a completely mixed activated sludge system. (Geiger-PTT)
W86-02095

APPLICATION OF THE TOTAL BARRIER OXIDATION DITCH ACTIVATED SLUDGE PROCESS FOR SINGLE STAGE NITRIFICATION-DENITRIFICATION OF HIGH STRENGTH WASTEWATER,
Reid Engineering Co., Fredericksburg, VA.
J. H. Reid.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 29-41, 2 fig, 1 tab.

Descriptors: *Denitrification, *Nitrification, *Activated sludge process, *Wastewater treatment, *Food-processing wastes, Aeration, Aerators, Am-

monia, Food processing industry, Industrial wastes, Biological wastewater treatment, Suspended solids, Biological oxygen demand, Activated sludge, Oxidation.

In January 1981, the first Total Barrier Oxidation Ditch activated sludge system in the U.S. began operation at a poultry processing plant to provide nitrification for ammonia removal, denitrification for nitrate removal, and enhance secondary BOD and suspended solids treatment. The barrier oxidation ditch basin is preceded by an anaerobic flow equalization pretreatment basin. The oxidation ditch operates at an average volume of 700,000 gal. Three activated sludge clarifiers are operated in parallel with a total effective settling area of 1350 sq ft. One chlorine contact basin is used for combined effluent disinfection and post aeration. The single stage, low load, continuous loop reactor extended aeration activated sludge process was selected for this treatment system upgrade, based on design loadings and performance capability. Performance data shows that the Total Barrier Oxidation Ditch can be utilized as a single activated sludge treatment process, to provide very high removals of carbonaceous and nitrogenous oxygen demand and total N during the warm season months between April and October. During these months nitrification efficiency was 99%, and total N removal efficiency was 92%. During the winter season months, nitrification efficiency was reduced to 97% and total N removal efficiency was reduced to 84%. The automation of aerator oxygen transfer rate to maintain a looped reactor intake zone dissolved oxygen concentration less than or equal to .2 milligrams/liter would stabilize denitrification efficiency in the warm season months and greatly improve the denitrification efficiency attainable during the winter season. (Geiger-PTT)
W86-02096

DEVELOPMENT OF ENERGY EFFICIENT ACTIVATED SLUDGE SYSTEMS THROUGH UTILIZATION OF NUTRIENT REMOVAL PROCESSES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. W. Randall.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 52-63, 2 fig, 4 tab, 8 ref.

Descriptors: *Nutrient removal, *Denitrification, *Biological wastewater treatment, *Wastewater treatment, *Cost analysis, Nutrients, Phosphorus removal, Oxidation, Activated sludge process, Energy, Aeration, Oxidation, Chemical oxygen demand.

Biological nutrient removal wastewater treatment processes have been adequately demonstrated under full-scale conditions to warrant general application. Due to their decreased oxygen requirements, these processes have the potential to substantially reduce the amount of energy that must be expended to treat a given wastewater. The energy saving aspects of denitrification have been thoroughly demonstrated by widespread application. The potential energy savings of biological P removal systems have far less documentation. Research using biological P removal has shown promise for high COD reduction, when truly anaerobic conditions prior to highly aerobic conditions are maintained. The oxidation ditch modification of the activated sludge process appears to be ideally suited for economic, energy efficient biological nutrient removal operation. Nutrient removal oxidation ditch design can be readily achieved using widely accepted techniques, such as Monod type equations. (Geiger-PTT)
W86-02097

MICROBIOLOGY OF FILAMENTOUS BULKING OF INDUSTRIAL AND DOMESTIC ACTIVATED SLUDGE,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
T. M. Williams, R. F. Unz, and K. Beard.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 64-77, 1 fig, 4 tab, 12 ref. CME-79189191.

Descriptors: *Activated sludge, *Microbiological studies, *Bacteria, *Biological wastewater treatment, *Culturing techniques, Wastewater treatment, Activated sludge process, Mixed liquor solids, Microorganisms, Separation techniques, Industrial wastewater, Municipal wastewater.

The distribution of filamentous microorganisms in bulking activated sludge obtained from several industrial and domestic wastewater treatment plants was investigated along with isolation procedures suitable for the recovery of filamentous microorganisms. Microscopic examination of mixed liquor specimens from treatment plants experiencing poorly settling solids, revealed the presence of one or more types of filamentous microorganisms. In general, treatment plants operated at low to medium organic loading rates produced activated sludge solids populated by Haliscomenobacter hydrossis, and Eikelboom types 0041, 0675, and 0803. Aeration basins with higher organic loading rates produced activated sludge solids populated by Sphaerotilus natans, Thiothrix spp., and types 1701 and 021 N. Pretreatment of samples from industrial and domestic sources prior to innoculation of culture media facilitated isolation of filamentous bacteria. A total of 42 axenic strains of bacteria, representing seven distinct groups of filamentous organisms, were isolated. The morphological and cytological features of the isolated bacteria are discussed. (Geiger-PTT)
W86-02098

UTILIZATION OF AN INDUSTRIAL WASTE OIL AS AN ALTERNATIVE FUEL FOR A MUNICIPAL SLUDGE INCINERATOR,
Tennessee Univ., Knoxville.
D. W. Weeter.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 99-107, 2 fig, 2 tab, 4 ref.

Descriptors: *Sludge disposal, *Oil recovery, *Oil wastes, *Recycling, *Sludge utilization, Wastewater treatment, Incineration, Wastewater reclamation, Cost analysis, Municipal wastewater, Waste recovery, Waste disposal, Industrial wastes.

A project to provide fuel beneficiation for a municipal sludge multiple hearth furnace incinerator at the Maryville Regional Wastewater Treatment Plant (MRWTP) is described. Waste oil sludge from the Aluminum Company of America (ALCOA) Tennessee operations was treated with alum and sulfuric acid to reclaim rolling oils. The MRWTP was modified to utilize the reclaimed oil. Fuel switching between natural gas and oil sludge was adopted along with plans to keep the incinerator temperature up when not burning sewage sludge. The new system had no major effects on water quality. The additional ash that was added by the oil was not hazardous and could be legally spread on nearby corn fields. A 50 inch induced draft fan was installed to meet New Source Performance Standards for air quality. The above ground oil storage vessel was diked to comply with EPA oil spill prevention regulations. Since the project was implemented, natural gas costs have decreased from $144 thousand to $1,000 per year. A waste exchange contract was developed between ALCOA and MRWTP.
W86-02099

BIOLOGICAL TREATMENT OF INDUSTRIAL WASTEWATERS IN THE USSR,
American Standards Testing Bureau, Inc., New York.
L. Shmidt.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 121-139, 4 fig, 4 tab, 4 ref.

Descriptors: *Biological wastewater treatment, *Industrial wastewater, *Sludge disposal, *Activated sludge process, *Wastewater treatment, Industrial wastes, Aeration, Chemical treatment, Sludge drying, Sludge disposal, Solid waste disposal, Pulp wastes, Waste disposal, Activated sludge.

Biological treatment is widely used for industrial wastewater treatment in the chemical, petrochemical, and pulp and paper industries in the USSR. The most widely used biological treatment process is the activated biological sludge process and its modifications. The classical plug-flow-recycle system or its modifications such as tapered or step aeration systems are most often used. The standard unit for the biological wastewater treatment facility includes an equalizer, a primary clarifier, an aeration tank and a secondary clarifier. Multi-stage systems for biological wastewater treatment have been designed over the last few years. Five categories of multi-stage systems are identified. To reduce the cost of industrial wastewater treatment, an increase in the loading of aeration tanks and biofilters is needed. The Baikal Pulp Mill wastewater treatment plant includes a biological wastewater treatment system, a chemical wastewater treatment system, lagoons for polishing and aerating wastewaters and sludge thickening, filtering, drying and combustion units. (Geiger-PTT)
W86-02100

FACILITY UPGRADES DUE TO HAZARDOUS MATERIALS REGULATIONS,
GTE Government Systems Corp., Mountain View, CA. Sylvania Systems Group-Western Div.
S. M. Hochstadt.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 158-172, 3 fig, 2 tab, 10 ref.

Descriptors: *Wastewater treatment, *Cost analysis, *Hazardous materials, *Waste storage, *Wastewater facilities, Maintenance costs, Operating costs, Waste disposal, Metal-finishing wastes, Wastewater management, Industrial wastes, Industrial wastewater.

Industry faces a multitude of government regulations dealing with the storage, use, and disposal of hazardous materials in order to protect the health and safety of employees, the public, and the environment. Environmental regulations are handled under the federally legislated Clean Water, Clean Air, and Resources Conservation and Recovery Acts. The discharge of industrial process wastewaters is usually regulated by a local water district or municipal public works department. Most recently, attempts have been made to regulate the storage of hazardous materials in underground tanks. GTE Government Systems Corporation uses four separate chemical and two waste storage facilities which are being upgraded after twenty years of operation. The waste treatment system of the plating shop will feature a package treatment system for cyanide destruction, Cr reduction, pH neutralization, flocculation, clarification, sludge thickening, water recycle and sodium hydroxide. Four waste storage and four reagent storage tanks will be included. A trend of decreasing capital expenses with sharp increases in operating and maintenance initially (but leveling off after 1984) is depicted with $<10\%$ annual increase for upgrading costs. (Geiger-PTT)
W86-02101

INDUSTRIAL WASTEWATER TREATABILITY STUDY ACHIEVING BCT/BAT TREATMENT,
Koppers Co., Inc., Pittsburgh, PA.
A. C. Middleton, J. R. Smith, M. R. Urbassik, R. E. Keffer, and P. W. Sawchuck.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 173-185, 3 fig, 4 tab, 5 ref.

Descriptors: *Organic compounds, *Chemical coagulation, *Bioassay, *Wastewater treatment, *Activated sludge process, Organic wastes, Flocculation, Suspended solids, Toxicity, Pilot plants, Separation techniques, Chemical treatment, Biological wastewater treatment.

The Federal EPA in March 1983 issued proposed effluent guidelines for the organic chemicals, plastics and synthetic fibers industry. The guidelines require conventional pollutant parameters to be regulated by best conventional technology (BCT) and the 129 priority pollutants by best available technology (BAT). To determine the degree of treatment required to meet these limits, Koppers

Company, Inc. conducted a complete on-site wastewater treatability study at its Oil City, Pennsylvania plant. A pilot plant study simulated wastewater pretreatment for oil/water separation, activated sludge treatment, and toxicity testing of the treated effluent. Results showed that pretreatment of wastewater by FEC13 coagulation/flocculation/settling was very effective for removal of suspended matter and emulsified organic material. GC/MS analysis for organic priority pollutants in one effluent sample showed below detectable limit concentrations for all priority pollutant parameters except phenol and 2,6-dinitroluene. Results from both static and continuous flow-through fish bioassays showed the final treated effluent to be nontoxic. (Geiger-PTT)
W86-02102

RATIONAL PROCEDURE FOR ESTABLISHING DISCHARGE CONCENTRATION LIMITS IN MUNICIPAL SEWER USE ORDINANCES,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
J. K. Farmer, S. J. Spiegel, and S. R. Garver.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 186-199, 10 tab, 10 ref.

Descriptors: *Wastewater treatment, *Effluent limitations, *Water quality standards, *Sludge disposal, *Industrial wastewater, Monitoring, Landfills, Wastewater facilities, Waste disposal, Municipal wastewater, Biological wastewater treatment, Water pollution sources, Sewer systems.

The General Pretreatment Regulations require that municipalities throughout the United States develop programs to monitor and control industrial wastewater discharges to their municipal sewer systems. Discharges to publically owned treatment works (POTW) are comprised of controllable and uncontrollable sources. The allocatable loading to the POTW for any particular substance would be derived by subtracting the uncontrollable source contribution from the total allowable POTW loading. The performance criteria to be considered in developing discharge standards includes influent and effluent effects, biological and sludge treatment, and sludge disposal. Limiting concentrations identified at specific points in the treatment system need to be translated back to the treatment plant influent. Since POTW sludges are subject to RCRA regulations if disposal is by landfilling, mathematical equations exist for calculating the maximum concentration of treatment plant influent which will prevent the sludge from being classified as hazardous. The controllable loading for each substance must then be translated to maximum industrial discharge limitations. (Geiger-PTT)
W86-02103

ELECTROLYTIC RECOVERY OF ZINC FROM METAL FINISHING RINSE WATERS,
Maryland Univ., College Park. Dept. of Civil Engineering.
R. W. Walters, and D. M. Vitagliano.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 251-264, 5 fig, 3 tab, 10 ref.

Descriptors: *Metal-finishing wastes, *Zinc, *Industrial wastes, *Waste recovery, *Electroplating, Heavy metals, Electrodes, Electrochemistry, Recycling, Wastewater treatment, Corrosion, Metals, Industrial wastewaters.

In an effort to meet Zn discharge limits at an electroplating firm, a review of the literature regarding electrolytic recovery of metals from dilute wastewater, an effluent characterization study to identify sources of Zn within the plant, and a preliminary bench-scale evaluation of the feasibility of electrolytic recovery of Zn, were undertaken. Results showed that the Zn automatic line accounted for 88% of the Zn discharged. An optimum strategy requiring less frequent dumping of rinse tanks would be to stagger tank dumps so that a plant discharge of 4 milligrams/liter (the discharge limit for Zn) would not be exceeded. A bench-scale, electrolytic recovery reactor was constructed and tested to study the technical feasibility of Zn removal from the plating bath rinse stream using this technique. Results showed that the reactor configuration was effective at removing Zn from the complexed, Zn cyanide wastewater. Agitation was important for achieving high rates of Zn deposition. Although corrosion had no noticeable effect on Zn removal rates, it could be a limiting factor economically for this type of wastewater. Use of lower NaCl doses resulted in comparable Zn removal with less electrode corrosion. (Geiger-PTT)
W86-02104

SOLUBLE-SULFIDE PRECIPITATION TREATMENT OF METAL FINISHING WASTEWATER,
Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD.
J. J. Resta, M. Daly, and M. Pressman.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 265-278, 5 fig, 4 tab, 10 ref.

Descriptors: *Chemical precipitation, *Sludge thickening, *Sulfides, *Industrial wastes, *Metal-finishing wastes, Chromium, Metals, Sludge drying, Cost analysis, Sludge disposal, Performance evaluation, Wastewater treatment, Industrial wastewater, Hazardous materials, Electroplating, Metals, Heavy metals.

The performance and operation of the soluble-sulfide precipitation treatment system (SSP) for the removal of metal from finishing wastewater was evaluated at the U.S. Army Belvoir Research and Development Center in Virginia. The SSP system can reduce hexavalent Cr under neutral conditions. A sodium metabisulfite reduction system was included to minimize the amount of sodium sulfide required. Several safety features were included to reduce generation of toxic hydrogen sulfide gas. Total effluent metal concentrations in the SSP system averaged 1 milligram/liter. Sludge generation averaged 0.3 gallons of sludge/1000 gallons of wastewater treated. The sludge thickening and dewatering process performed adequately without the use of sludge conditioners. Chemical costs averaged $0.30/1000 gallons treated waste. The reactivity of the SSP system sludge could not be determined because the EPA has not promulgated a method for evaluating sulfide sludges. If the SSP sludge is determined to be a reactive hazardous waste, sludge disposal costs could limit the use of SSP treatment technology. (Geiger-PTT)
W86-02105

CO-PRECIPITATION OF HEAVY METALS WITH SOLUBLE SULFIDES USING STATISTICS FOR PROCESS CONTROL,
Talbot (Richard S.) and Associates, Inc., Media, PA.
R. S. Talbot.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 279-288, 8 tab, 3 ref.

Descriptors: *Industrial wastewater, *Heavy metals, *Chemical precipitation, *Wastewater treatment, *Metal-finishing wastes, *Heavy metals, Chemical treatment, Sulfides, Industrial wastes, Flocculation, Metals, Electroplating, Statistical methods.

The Talbot Process of sulfide co-precipitation was developed to help electroplating industries meet discharge pretreatment standards. The patented Talbot Process, owned by Richard S. Talbot and Associates, Inc., is used for the removal of metals that are difficult to precipitate as a metal hydroxide. The process can be used in both batch and continuous flow treatment operations, and is easily controlled through the use of statistics. The Talbot Process of sulfide co-precipitation produces a lower dissolved heavy metal content for the metals to be precipitated than conventional hydroxide precipitation alone. Sulfide co-precipitation produces a higher solids settling rate, and enhanced flocculation with anionic, organic polymers. A smaller quantity of sludge is produced as compared with conventional hydroxide precipitation leading to lower sludge disposal costs. The Talbot Process can easily be added to existing conventional systems to protect against future, more stringent heavy metals discharge standards. (Geiger-PTT)
W86-02106

EFFECT OF CHELATING AGENTS ON THE REMOVAL OF HEAVY METALS BY SULFIDE PRECIPITATION,
Purdue Univ., Lafayette, IN. Dept. of Civil Engineering.
R. W. Peters, and D. Bhattacharyya.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 289-317, 17 fig, 10 tab, 16 ref. CR-807760.

Descriptors: *Chemical precipitation, *Sulfides, *Heavy metals, *Chelating agents, Metal complexes, Chemical treatment, Chemical coagulation, Metals, Wastewater treatment, Copper, Zinc, Cadmium, Flocculation, Hydrogen ion concentration, Chelation.

The precipitation of metal sulfides was studied under both batch and MSMPR precipitation conditions for various metals, pH conditions, and EDTA concentrations. EDTA forms very strong metal chelates which interfere with the precipitation of ZnS. Weak chelating agents form weak metal chelates; formation of metal sulfide precipitates predominates. Removal of Cu is nearly complete even in the presence of EDTA. The Zn system shows that a phase transformation from an initial amorphous kinetically favored precipitate to a more crystalline form occurs. The Cu-Zn, Cu-Cd, and Cd-Zn systems behave like a single metal. After CuS precipitation is nearly complete, the ZnS reaction becomes significant. For more complex multi-metal systems, removal of Cu is nearly complete, the ZnS reaction becomes significant. For more complex multi-metal systems, removal of Cu is nearly complete, while removal of Zn and Ni were poor. For the continuous precipitation of ZnS, particle size distributions were poor. Although removal of Zn is hindered by EDTA, increased growth rates and larger dominant particle sizes are observed with increasing EDTA concentrations. The observed larger particle sizes were attributed to flocculation and formation of metal hydroxide precipitates. (Geiger-PTT)
W86-02107

REMOVAL OF HEAVY METALS IN POTW USING ALUM OR SODIUM ALUMINATE FOR PHOSPHORUS REMOVAL,
Rensselaer Polytechnic Inst., Troy, NY.
D. B. Aulenbach, N. L. Clesceri, M. A. Meyer, C. Vasudevan, and E. Beckwith.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 318-330, 3 tab, 6 ref.

Descriptors: *Chemical treatment, *Heavy metals, *Alum, *Aluminum, *Sodium compounds, Metals, Chromium, Cadmium, Industrial wastes, Copper, Lead, Antimony, Nickel, Beryllium, Mercury, Zinc, Thallium, Phosphorus removal, Wastewater treatment, Industrial wastewater.

The removal of heavy metals by alum or sodium aluminate used for P removal was studied in three publically owned treatment works in Massachusetts - the Pittsfield, Medfield and the Fitchburg. By measuring the heavy metals concentrations at the plants during late summer when the Al salt is added and continuing measurement after the discontinuance of Al salt addition, any difference in heavy metals removal may be attributed to the discontinuance of the Al salt addition. Results showed that the addition of alum or sodium aluminate at dosages which effectively remove phosphorus can remove Cu, Cr and Pb in wastewaters. Of the remaining metals analyzed, no difference was observed with and without Al salt addition for Cd or Sb, nor was there any difference in TOC removal. Hg was effectively removed to below the detection limit by primary sedimentation, so no further removal was achieved during secondary treatment when the alum/aluminate was added. The remaining metals analyzed (Ni, Be, Tl) were not present above the detection limits in the plant influents, and hence their removal could not be evaluated. (Geiger-PTT)

W86-02108

EXPERIMENTAL STUDY OF THE EFFECTIVENESS OF ALUMINUM CHLORIDE FOR CLARIFYING WASTEWATER,
Villanova Univ., PA. Dept. of Chemical Engineering.
J. M. Courtney, and D. D. Joye.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 343-350, 3 tab, 5 ref.

Descriptors: *Aluminum chloride, *Clarification, *Cost analysis, *Food-processing wastes, *Flocculation, Aluminum, Ferric chloride, Alum, Industrial wastewater, Chemical precipitation, Wastewater treatment, Turbidity, Chemical coagulation, Cost analysis, Industrial wastes.

The effectiveness of aluminum chloride for clarifying wastewater was determined relative to two widely used inorganic coagulating/flocculating agents, alum and ferric chloride. Actual wastewater samples, prior to treatment, were obtained from a municipal treatment plant and several industrial food processing plants. The performance of the flocculating agents was evaluated on the basis of turbidity reduction and sludge volume in standard jar tests and settling cones. The results of this study showed aluminum chloride to be in most cases as effective as alum or ferric chloride at optimum dosage. When economics are considered, aluminum chloride may be an attractive replacement for currently used inorganic flocculating agents in the treatment of industrial wastewater. (Author)
W86-02109

SOLVENT INTERACTIONS WITH COMPLEX, CONCENTRATED INDUSTRIAL WASTEWATERS,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
W. M. Ollinger, and R. C. Ahlert.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 384-394, 5 fig, 2 tab, 4 ref.

Descriptors: *Leachates, *Phenols, *Chemical reactions, *Industrial wastewater, *Organic solvents, Industrial wastes, Landfills, Wastewater treatment, Solubility, Solvents, Separation techniques, Anions.

The presence of components of a landfill leachate solute matrix alters the distribution of phenol and o-chlorophenol between organic and wastewater phases. The alteration is more pronounced with phenol than with o-chlorophenol due to solute-salt interactions in the aqueous phase which is favored by phenol. The components in the leachate solute matrix that contribute to the salting out of phenol, to the greatest extent, appear to be the large inorganic anions (carbonate and sulfate ions). High concentrations of these anions in the leachate stem from the pretreatment process. High levels of acetic, propionic, and butyric acids also contribute to the observed change in the phenol distribution. Solubility studies are needed to determine in which phase salt effects are more pronounced. (Geiger-PTT)
W86-02111

INVESTIGATION INTO THE WATER QUALITY BENEFITS OF CHLORINATING PAPERMILL EFFLUENTS,
Pennsylvania Dept. of Environmental Resources, Harrisburg.
R. H. Shertzer, and R. F. Frey.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 395-410, 4 fig, 6 tab, 15 ref.

Descriptors: *Chlorination, *Coliforms, *Wastewater treatment, *Pulp wastes, *Water quality, Chlorine, Biological properties, Water pollution effects, Macroinvertebrates, Industrial wastes, Aquatic bacteria, Industrial wastewater, Chemical properties, Escherichia coli, Klebsiella, Metals.

The effectiveness of chlorine addition in the control of coliform bacteria in two treated papermill wastewater discharges, and in the east branch of Brandywine Creek, Pennsylvania, was examined along with chemical and biological changes in the creek due to chlorination. Eleven sampling stations were established to assess water chemistry, bacteriology, and aquatic biology from July to October 1982. Results showed that significant reductions in bacteria density during chlorination occurred only at Station 3. The densities of both Klebsiella and E. coli in the effluents of both papermills were reduced after the application of chlorine. No significant improvement in water quality is documented as a result of chlorination of the papermill effluents. Neither metals discharged from the mills, nor total residual chlorine exerted a toxic influence on aquatic macroinvertebrates. Under such conditions, the instream biological community is already somewhat limited by other discharge components making any impact attributable to chlorine difficult to detect. (Geiger-PTT)
W86-02112

CASE HISTORY - OPTIMIZATION OF DISSOLVED AIR FLOTATION SLUDGE THICKENER REDUCES SLUDGE TREATMENT COSTS BY ELIMINATING ADDITIONAL DEWATERING PROCESS,
J. Wozniak, and T. L. Collett.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 411-417, 3 fig.

Descriptors: *Biological wastewater treatment, *Sludge drying, *Cost analysis, *Polymers, *Oil refineries, Operating costs, Maintenance costs, Wastewater treatment, Industrial wastes, Dewatering, Sludge thickening.

In 1983, a program was initiated to reduce the costs of biological sludge treatment at a Northeast crude oil refinery and chemical plant known as the Conservation Area. The biological sludge was thickened by an optimized Dissolved Air Flotation unit (DAF). A Gravity Belt Filter Presses (GBFP's) dewatering step was eliminated, reducing overall treatment costs by $900 thousand per year. The DAF thickening performance was increased about 50%. Mechanical and polymer changes allowed for easier process start-up and a 25% capacity increase. After optimization, the final sludge concentration was consistently 10-12% total solids. The optimized in-line dilution of polymer significantly reduced costly equipment, maintenance and operator time. About one-third of the total cost savings realized represents the polymers no longer used in the GBFP's. The maintenance cost savings was about one-third of the total savings and the remaining savings were attributed to the energy costs required by the GBFP's, the polymer dilution system and the building where everything was located. (Geiger-PTT)
W86-02113

BELT FILTER PRESS SELECTION FOR CHEMICAL PROCESS WASTE BIOSLUDGES,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
K. N. Wood, and E. L. Mongan.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 418-432, 7 fig, 3 tab, 20 ref.

Descriptors: *Sludge drying, *Sludge, *Flocculation, *Sludge conditioning, *Sludge filters, Dewatering, Wastewater treatment, Sludge solids, Drying.

The design features and unique concepts employed by the various belt filter presses (BFP) used for sludge dewatering at the DuPont facilities are described. The belt press consists of a three-stage process: sludge flocculation, gravity drainage of free water, and belt pressing of dewatered sludge. Some presses offer an extra high pressure zone which is advantageous with fibrous or inorganic sludges. The Flocpress accomplishes flocculation in a rotary drum. An earlier version of the Unimat has V-shaped pockets for gravity drainage. The R. B. Carter Company BFP uses a rotating drum for flocculation and a screen-lined drum for thickening. The Klampress flocculates sludge by passing it through a vortex mixer. Testing methods of BFP's should involve selection of effective polyelectrolytes for sludge conditioning, determining mixing time and energy requirements for flocculation, recording rate and quantity of filtrate release by gravity drainage and by compression dewatering, and calculating filter cake dryness. It is suggested that more than one press manufacturer's equipment be evaluated on-site, and ample startup time be allowed for finetuning of the polymer addition system, belt tracking and other potentially tempermental aspects of the belt filter press installation. (Geiger-PTT)
W86-02114

MODELING OF REACTIONS BETWEEN AQUEOUS CHLORINE AND NITROGENOUS COMPOUNDS,
Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
R. A. Isaac, and J. C. Morris.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 63-75, 5 fig, 5 tab, 9 ref. DAMD 17-77-C-7051.

Descriptors: *Wastewater treatment, *Chlorination, Fate of pollutants, Model studies, Chloramines, Nitrogen compounds, Amino acids, Organic compounds, Decomposition, Chemical reactions.

A computer model is used to predict the relative amounts of selected chloramines in wastewaters. Common organic nitrogen compounds in wastewater are methylamine, di- and trimethylamine, and the amino acids. The ratio of organic N to total N in wastewaters is 0.45-1.00, median 0.92. Results show that the nature of the organic nitrogen is an important factor in the chloramine/organic-NCl distribution. In the case of glycylglycine it is likely that the amine-N and not the amide-N is being chlorinated. Decomposition of chloramines was studied by pouring a solution of HOCl into a rapidly stirred solution of the nitrogenous compound and monitoring disappearance by titrimentry or spectrometry. Half-lives (in min) of chloramines (with varying pH and temperatures) of the following compounds were as follows: alanine, 76-96; glycine, 1300-9000; histidine, 34-79; leucine, 66-79; phenylalanine, 52; serine, 33-72; tryptophan, too fast to measure; creatinine, 3300; glycine-N-acetyl ester, 19,000; glycine ethyl ester, 33-945; glycylglycine, 930-14,000; sarcosine, 192-257; and sarcosine anhydride, 2,900-12,900. Calculations show that low concentrations of dichloramine enhance disinfection but organic chloramines have no practical value in disinfection. (Cassar-PTT)
W86-02137

NATURAL DECHLORINATION KINETICS OF SECONDARY MUNICIPAL EFFLUENTS,
Beak Consultants Ltd., Mississauga (Ontario).
M. P. Shaw, and W. J. Snodgrass.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983, p 113-123, 3 fig, 2 tab, 20 ref.

Descriptors: *Wastewater treatment, *Fate of pollutants, *Chlorination, *Kinetics, Ponds, Design criteria, Wastewater ponds, Ultraviolet radiation, Organic matter.

The chemical kinetics of dechlorination in a natural wastewater dechlorination pond were investigated, considering temperature, ultraviolet radiation, and organic concentration. The kinetic constants delta = 0.00056 per min and gamma = 3270 degrees K should be used in the modified Arrhenius equation to predict the first-order rate constants describing natural dechlorination kinetics. Chlorine concentration should be computed in molar values. Dechlorination pond design should be based on the slowest expected kinetics, which occur in winter with ice cover. Atmospheric levels of ultraviolet radiation roughly double the first-order rate constant. (Cassar-PTT)

W86-02142

CHLORINE DEMAND: STUDIES CONCERNING ITS CHEMICAL BASIS,
Maryland Univ., College Park. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W86-02147

FORMATION OF ORGANOHALOGEN COMPOUNDS IN CHLORINATED SECONDARY WASTEWATER EFFLUENT,
Florida International Univ., Miami. Drinking Water Quality Research Center.
For primary bibliographic entry see Field 5B.
W86-02169

NONVOLATILE ORGANICS IN DISINFECTED WASTEWATER EFFLUENTS: CHEMICAL CHARACTERIZATION,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W86-02170

FORMATION OF VOLATILE HALOORGANIC COMPOUNDS IN THE CHLORINATION OF MUNICIPAL LANDFILL LEACHATES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-02171

WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES,
For primary bibliographic entry see Field 5F.
W86-02324

REGIONALIZATION OF WATER SUPPLY AND SANITATION SERVICES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W86-02326

SEWERAGE: THE DEVELOPING COUNTRY DILEMMA,
Cole and Co. Ltd., Ottawa (Ontario).
M. G. McGarry.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 125-141, 1 fig, 3 ref.

Descriptors: *Sewer systems, *Wastewater treatment, *Cost-benefit analysis, *Developing countries, *Sanitation, Sewers, Maintenance costs, Cost analysis, Public health, Project planning, Wastewater disposal, Waste management, Economic aspects.

In the mid-nineteenth century many American and European cities had to construct sewers to handle problems of wastewater disposal. Whereas sewerage and treatment plants are being designed today to overcome environmental pollution problems of the industrialized states, the problems facing the large low-income populations of developing countries are human health-related. Usually consultants to planning projects in developing countries come from already developed nations, and these consultants have little experience with alternatives to sewerage. A cost-benefit analysis of projects to provide sewerage to Taipei, Taiwan is given to illustrate the difficulties involved in making such an assessment. Three costs of sewerage that are often overlooked are the cost of flush water, loss of the reuse potential of excreta, and increased costs for treatment of receiving waters for sewage. The necessary health education programs needed to improve hygiene in the home rarely accompany the introduction of sewerage. Community support in the education of people in sanitary practices is essential. Although technical alternatives to sewerage are now available, it will take many more years before effective delivery mechanisms are in place and operating. Plans for sewering a city center do not usually address the health problems of peripheral squatter settlements. (Geiger-PTT)

W86-02332

WET METHOD FOR EXCRETA DISPOSAL,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
R. L. Droste.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 157-176, 6 fig, 1 tab, 34 ref.

Descriptors: *Septic tanks, *Wastewater disposal, *Seepage pits, *Developing countries, *Sludge disposal, Waste disposal, Sewer systems, Septic sludge, Septic wastewater, Seepage, Evapotranspiration, Leaching, Economic aspects, Public health, Sanitation, Social aspects.

Financial and economic costs of wet methods for excreta disposal are less than those of a full sewerage system. The aqua-privy (AP) can handle feces and urine, with an input of water. The AP consists of a drop pipe from the toilet and a nonbaffled container discharging to a soakaway. The tank is mainly sized on the basis of the long-term buildup of solids. Since the failure to maintain the water seal is often the reason for AP failure, the addition of sullage is recommended as a design standard. Sludge levels in the AP should be checked annually. The septic tank system also relies on the on-site disposal of wastes. Estimation of the quantity of wastewater flow is the critical factor in the sizing of septic tanks. The most common means of effluent disposal is in seepage or leaching fields. The most important characteristic of the disposal field is its hydraulic conductivity. Septic tanks, AP and their leaching fields must be located away from wells, streams, and buildings. If impermeable rock or soils of low permeability exist, the evapotranspiration bed appears to be a feasible alternative. Communal toilets are often unacceptable due to inconvenience and lack of proper cleaning. Health problems may arise if sludge cleaning is not performed, water seals are not maintained, or seepage fields become clogged. The success of any system relies its acceptance by its users. (Geiger-PTT)
W86-02333

LOW-COST ALTERNATIVES TO SEWERAGE,
Cole and Co. Ltd., Ottawa (Ontario).
M. G. McGarry.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 143-156, 7 fig, 13 ref.

Descriptors: *Latrines, *Septic tanks, *Wastewater disposal, *Developing countries, *Sludge disposal, Waste disposal, Solid waste disposal, Economic aspects, Public health, Sanitation, Social aspects, Design criteria.

The main cause of failure of latrinization programs in the past are social and educational failure. The conventional pit latrine has been advocated by aid programs and colonial governments as part of health care projects. In dense squatter settlements, redigging of the pits after several years may cause problems in areas where there is already limited space. The vented improved pit latrine has its pit offset and a vent pipe rising from the pit's concrete cover slab. Pit desludging is done by the municipality. The revised earth closet has alternating pits to increase the capacity for storage and lengthen the time between desludging. Once filled, the first pit is closed and its contents left to digest while the superstructure is placed above the second pit. The Reed's odorless earth closet has the pit offset from the superstructure by using a straight or curved chute. This latrine is not recommended because the chute often becomes clogged. The Mozambiquan latrine is made of cement and is designed as a circular slab located over a circular pit. This type of latrine is well suited to areas where raw materials are scarce and the subsoil is unstable. The principal elements of the pour-flush latrine are the bowl, trap, and pipe. The bowl is designed to be flushed with 1-2 liters of water poured by hand. The pour-flush latrine provides a water seal between the household and the excreta storage pit. The vacuum truck and vault system collects excreta and stores it beneath the toilet for regular collection by the municipality. (Geiger-PTT)

W86-02334

EXCRETA REUSE OPTIONS: COMPOSTING AND BIOGAS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
R. L. Droste.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 177-200, 5 fig, 5 tab, 39 ref.

Descriptors: *Recycling, *Waste disposal, *Composting, *Biogas, *Sludge digestion, Anaerobic digestion, Sludge disposal, Economic aspects, Aerobic digestion, Social aspects, Methane, Waste management, Digestion, Fertilizers, Sludge utilization.

Reuse options for excreta disposal help solve problems of waste disposal while turning a waste into a resource. Compost latrines have not met with widespread success, due to improper user attitudes. Compost units can be designed for continuous or batch operation. The aerobic processes are usually continuous and centered around the Swedish design known as the Clivus Multrum. Outside of the Swedish experience with multrums, the batch type anaerobic composters have achieved the most significant success, especially in developing countries. Certain sociocultural factors have to be considered for composting to be successful. User education and care are needed. The users must be willing to handle the composted humus, and there must be a market or local use for the product. Lime or ash addition is preferable in double-vault latrines because of their odor-absorption capabilities. Definitive health studies on pathogen survival in composted wastes are lacking. Most data point to the survival of viruses and helminths, especially Ascaris. A minimum one-year retention time is recommended for essentially complete kill. Anaerobic digestion under suitable conditions for biogas production does not render an effluent slurry sufficiently low in pathogen content for use as fertilizer. A brief review of the theory and principles of anaerobic sludge digestion confirms the limits of the process. Use of biogas energy is considered along with operation and design of digesters. (Geiger-PTT)
W86-02335

OXIDATION PONDS AND FISH CULTURE,
Cole and Co. Ltd., Ottawa (Ontario).
M. G. McGarry.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 201-218, 4 fig, 19 ref.

Descriptors: *Fish farming, *Aquaculture, *Oxidation ponds, *Public health, *Waste disposal, Sludge utilization, Anaerobic digestion, Aerobic digestion, Wastewater treatment, Carp, Oxidation process, Wastewater disposal, Viruses, Pathogenic bacteria, Parasites, Pathogens, Coliforms, Developing countries.

The oxidation pond has become widely recognized as the most efficient, least costly method of primary and secondary treatment of wastewaters. Conventional oxidation ponds are classified into three types: anaerobic, facultative and maturation. The advantages of using anaerobic, facultative and maturation ponds in tropical developing countries are numerous. Untreated wastewater can be fed directly into facultative ponds, where wastes are treated both anaerobically and aerobically. Maturation ponds are placed after a series of facultative ponds and usually recieve effluents below 75 milligrams/liter BOD. Land requirement for totally facultative and maturation pond systems can be considerably reduced by placing anaerobic ponds in front of the first facultative pond. To maximize algae production for use as animal feed, oxidation ponds can be operated at detention periods of 3-4 days and depths of 20-40 cm as high-rate algae ponds. In East Asia, the practice of raising fish on nightsoil (domestic excreta) is common. The introduction of fish to sewage-fed oxidation ponds reportedly increases the quality of the final effluent. Well designed and operated oxidation and maturation ponds can achieve significant viral removals. Fish resist penetration of viruses into their muscle

tissue while shellfish do not. Pathogenic bacteria may penetrate the meat of fish and cause health problems in improperly cooked fish. Series oxidation ponds are capable of efficient removal of many human parasites. (Geiger-PTT)
W86-02336

COST-EFFECTIVE WATER SUPPLY AND SANITATION PROJECTS FOR DEVELOPING COUNTRIES,
International Bank for Reconstruction and Development, Washington, DC. Dept. of Transportation and Water.
For primary bibliographic entry see Field 6C.
W86-02337

SANITATION ASPECTS OF WATER SUPPLY AND EXCRETA DISPOSAL,
Ministry of Health, Lilongwe (Malawi).
For primary bibliographic entry see Field 5E.
W86-02340

OPERATION AND MAINTENANCE OF WATER SUPPLY AND SANITATION SYSTEMS,
Walker and Partners Ltd., Ottawa (Ontari).
B. Grover.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 327-341, 8 fig, 1 ref.

Descriptors: *Maintenance, *Project planning, *Wastewater treatment, *Water supply development, *Sanitation, Evaluation, Management planning, Future planning, Maintenance costs, Developing countries, Manpower, Economic aspects, Water supply, Education.

In order to operate properly, water supply and sanitation systems must receive the proper maintenance. Planned maintenance attempts to anticipate and avoid interruptions of service. Breakdown maintenance, a form of crisis intervention, tries to restore service in malfunctioning systems as quickly as possible. In a survey conducted by the General Accounting Office which showed failure of the majority of wastewater treatment plants to meet their discharge standards, the lack of proper maintenance was cited as the second most frequent cause of failure. In developing countries, systems are frequently broken down. Local resources are usually all that is needed to keep a hand pump water supply system in operation. The United Nations Children's Fund conducted an educational program on the maintenance of water supplies. Piped water supplies that involve treatment and pumping are also very vulnerable to failure in rural areas. To keep water and wastewater systems operating properly, the agency responsible for maintenance must have reliable transport fleet. When planning, financing, construction and operation of a system are all undertaken locally, local personnel can handle any maintenance problems. Design criteria should consider local customs and the use of locally available materials. For the effective operation and maintenance of water and sanitation systems, motivation, good management, money and manpower must be present. In planning new water supply and sanitation projects, the planner should first evaluate what is wrong with the present system. (Geiger-PTT)
W86-02341

5E. Ultimate Disposal Of Wastes

PHYSICAL PROPERTIES AND LEACH TESTING OF SOLIDIFIED/STABILIZED INDUSTRIAL WASTES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-147983, Price codes: A07 in paper copy, A01 in microfiche. EPA-600/2-82-099, December 1982. 135 p, 21 fig, 33 tab, 15 ref, 3 append. EPA-IAG-D4-0569.

Descriptors: *Sludge treatment, *Waste disposal, *Industrial wastes, *Leaching, Landfills, Metals, Heavy metals, Waste treatment, Toxic wastes, *Waste stabilization, *Water pollution control.

Physical property and leaching tests were conducted to assess the engineering characteristics and pollution potential of five industrial wastes (sludges from electroplating, Ni-Cd battery manufacture, pigment production, chlorine production brine, and glass etching). Four solidification/stabilization processes were used to produce different types of treated-waste products: (1) one resembling low-strength concrete, (2) a rubber-like solid, (3) a solid plastic-encased block, and (4) a soil-like material. No correlation between the physical properties of the treated products and their ability to contain the sludge constituents in leach testing was found. The soil-like product had the highest permeability and lowest strength and durability, but it gave the best overall containment of all the treated-waste products except the polyethylene-jacketed waste. Although the rubber-like solid was strong and durable, it produced the leachate with the highest concentration of pollutants. Leach tests were conducted with carbon dioxide-saturated water at a flow rate of 0.00005 cm/sec for 1-2 years. In all cases leachates were higher in heavy metals and anions than drinking water standards. No treatment process other than plastic encapsulation uniformly reduced the concentration of all potential pollutants for all sludge types; however, the overall pollution potential was lowered. In some cases, additional leachable materials were added in the treatment process. Some treatment processes increased the solubility of certain constituents so that they were lost at higher rates than in untreated sludge. (Cassar-PTT)
W86-02001

HAZARDOUS AND TOXIC WASTES: TECHNOLOGY, MANAGEMENT AND HEALTH EFFECTS,
For primary bibliographic entry see Field 5B.
W86-02041

OPERATING EXPERIENCE IN HAZARDOUS WASTES DISPOSAL BY POZZOLANIC CEMENTATION,
Envirosafe Services, Inc., Horsham, PA.
C. L. Smith, and T. Longosky.
IN: Hazardous and Toxic Wastes: Technology, Management and Health Effects, The Pennsylvania Academy of Science, Easton, PA. 1984. p 64-76, 3 fig, 7 tab, 10 ref.

Descriptors: *Waste disposal, *Cement, Pozzolanic cementation, Landfills, Envirosafe process, Organic compounds, Sludge, Paper coating industry, Steel industry, Metal-finishing industry, Oil, Fly ash, Encapsulation.

A pozzolanic cementation process has been used for hazardous waste disposal by the Envirosafe Services facility, Honeybrook, Pa., since early 1980. Fly ash is blended with the waste, then lime is added. The basic chemistry is similar to that of portland cement hydration and hardening, producing a material of high compressive strength with permeability coefficients in the range of 10 to the minus 6 power cm/sec. The processed waste, with the consistency of damp soil, is trucked to a landfill, where it is spread, graded, and compacted. Essentially zero leachate is generated by the landfill, and no impact on monitoring wells has been detected. Some wastes are not suitable for this process, notably those with high sugar content. Specific details are given for several wastes: paper coating wastes (50% complex organics with inorganic pigments and clays), air pollution residue from steel production (zinc, iron, calcium), and rolling mill oil-bearing sludge (quartz, oil and grease, heavy metals). (Cassar-PTT)
W86-02042

GEOLOGICAL FACTORS IN DISPOSAL SITE SELECTION,
Pennsylvania State Univ., University Park. Dept. of Geosciences.
R. F. Schmalz.
IN: Hazardous and Toxic Wastes: Technology, Management and Health Effects, The Pennsylvania Academy of Science, Easton, PA. 1984. p 124-136, 52 ref.

Descriptors: *Waste disposal, *Water quality control, *Landfills, *Geology, Geohydrology, Soil properties, Groundwater movement.

Reinforced concrete vaults and other man-made containers for burial of hazardous waste have failed within 20 or 30 years in many instances. Therefore, proper selection of a suitable geological site is very important for long-term safe storage. Essential criteria for a successful shallow land burial site are as follows: (1) sufficient depth of soil or regolith to accomodate the burial cells, (2) a water table of sufficient depth to guarantee that the cells are above the zone of saturation at all times, (3) a surface water regimen which allows drainage away from the cells, (4) soil or regolith which is homogeneous and impermeable so that groundwater flows aways from the site, and (5) a stable geological environment. Guidelines are given for choosing or excluding a site for hazardous waste disposal. A four-level process is used to quickly eliminate unsuitable sites from consideration. The first level excludes sites on a regional basis (volcanic activity, flood plains, population centers, permeable bedrock, etc.). The second level considers site-specific problems (eliminating places subject to exceptional storms, landslides, local areas of fractured rock, steep slopes, mines, usable aquifers). Interactive site-specific criteria consider interrelationships between two or more factors, such as soil transmissivity and depth to water table. Factors which enhance the suitability of a site for waste disposal include transportation facilities, backfill sources, and absorbant or neutralizing soil. (Cassar-PTT)
W86-02043

TIME PERSPECTIVE IN THE SUBSURFACE MANAGEMENT OF WASTE,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 5B.
W86-02044

SITING HAZARDOUS WASTE MANAGEMENT FACILITIES: THEORY VERSUS REALITY,
Boston Univ., MA. Dept. of Urban Affairs and Planning.
For primary bibliographic entry see Field 5G.
W86-02045

COAL TAR WASTES: THEIR ENVIRONMENTAL FATE AND EFFECTS,
Pennsylvania Power and Light Co., Allentown.
For primary bibliographic entry see Field 5B.
W86-02046

TOXIC AND HAZARDOUS WASTES,
For primary bibliographic entry see Field 5D.
W86-02094

UTILIZATION OF AN INDUSTRIAL WASTE OIL AS AN ALTERNATIVE FUEL FOR A MUNICIPAL SLUDGE INCINERATOR,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 5D.
W86-02099

BIOLOGICAL TREATMENT OF INDUSTRIAL WASTEWATERS IN THE USSR,
American Standards Testing Bureau, Inc., New York.
For primary bibliographic entry see Field 5D.
W86-02100

FACILITY UPGRADES DUE TO HAZARDOUS MATERIALS REGULATIONS,
GTE Government Systems Corp., Mountain View, CA. Sylvania Systems Group-Western Div.
For primary bibliographic entry see Field 5D.
W86-02101

FIXATION OF SEWAGE SLUDGE AND FLY ASH; AN ALTERNATIVE METHOD FOR OCEAN DISPOSAL,
State Univ. of New York at Stony Brook.
C-S. Shieh, and F. J. Roethel.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 433-443, 5 fig, 3 tab, 15 ref.

Descriptors: *Solid waste disposal, *Ocean dumping, *Sludge disposal, *Fly ash, *Mine wastes, Waste disposal, Sludge drying, Sludge conditioning, Dewatering, Sludge thickening, Reefs, Chemical properties.

The Coal Waste Artificial Reef Program (C-WARP) has proven the environmental acceptability of waste stabilization and ocean dumping of dewatered sludge mixed with fly ash while forming an artificial reef for fishing. Test samples of solid cylinders (11.9 cm by 10.2 cm) or a fly ash-sewage sludge (FA-SS) mixture were tested for permeability, compressive strength, electron microscopic appearance, and chemical properties (elemental analysis). Results showed that the compressive strength of the FA-SS block was a function of curing time, temperature, moisture, and additive contents. Scanning electron micrographs of sewage sludge indicate that the sludge is composed of an irregular flaky material. Permeabilities ranged from 0.00001 to 0.000001 cm/sec over the periods of the experiment. Concentrations of Al, Cu, Zn and Pb in the exterior portions of the FA-SS blocks increased with time after exposure to seawater while a steady decrease of Cd was also observed. These findings show that blocks maintain their structural integrity and may provide an acceptable option for ocean dumping of solid wastes. (Geiger-PTT)
W86-02115

DEALING WITH LANDFILLED HAZARDOUS SLUDGE, OTHER ALTERNATIVES,
Maryland Dept. of Health and Mental Hygiene, Baltimore. Office of Environmental Programs.
G. Z. Francis.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 444-455, 4 fig, 3 tab.

Descriptors: *Groundwater pollution, *Landfills, *Leachates, *Sludge disposal, *Water pollution prevention, Leaching, Waste disposal, Solid waste disposal, Water quality, Industrial wastes, Calcium carbonate, Nickel, Boreholes, Acid rain, Cost analysis.

A study was conducted to test leachate and groundwater quality of a major industrial facility in Maryland. The landfilled sludge consists of a mixture of three types of wastes: electroplating sludges, paint residues, and industrial painting wastewater treatment sludges. Twelve boreholes were drilled in the vicinity of the disposal site and groundwater monitoring wells were installed in five of these boreholes. Groundwater was monitored continuously for three months. No evidence of groundwater quality deterioration was observed over a 4-yr period, although natural precipitation was suspected as a source of leachate for Ni. It was recommended that the site be closed and a 1-inch layer of calcium carbonate be applied to its surface to neutralize acid precipitation in the facility's area for more than 800 years. Total closure cost is estimated at $100,000 to $120,000 while digging out the waste and disposing of it by some other means would cost an estimated $900,000 to $1,000,000. (Geiger-PTT)
W86-02116

ENVIRONMENTAL AND ENGINEERING ASPECTS RELATED TO THE RESTORATION OF A FERROUS SULFATE (COPPERAS) WASTE DISPOSAL SITE,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
W. R. Knocke, J. T. Novak, G. L. Goodman, M. Morris, and J. Moslehi.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 487-496, 2 fig, 3 tab, 2 ref.

Descriptors: *Solid waste disposal, *Landfills, *Leachates, *Ferrous sulfate, *Groundwater pollution, Waste disposal, Acidic water, Land disposal, Sulfates, Linings, Leaching, Water pollution sources, Environmental effects, Water pollution effects, Cleanup, Clays.

An assessment of environmental damage associated with the burial of waste ferrous sulfate or copperas at an abandoned Ti processing facility in Nelson County, Virginia and related engineering improvements associated with the sites cleanup was made in the summer of 1983. Results showed extreme cracking of the top clay liner which allowed rainfall to percolate directly into the buried copperas. The extremely acidic surface seepage erradicated all vegetation with which it came in contact. Evaluations of soluble Al concentrations in roundwater showed a significant change in the mineralogical structure of contaminated soils which was hypothesized to be directly related to the release of Al during acidic decomposition of the soil matrix. An increase in permeability as a function of exposure time to copperas leachate could also occur. River water samples collected along the Piney River both upstream and downstream of all identified surface runoff locations at the plant site, showed significant decreases in pH due to groundwater contamination. Laboratory tests show increased permeabilities of clay lining materials due to copperas. Remedial action included regrading the surface, depositing a 2-ft clay cover and planting vegetative cover to aid in rainfall drainage and evapotranspiration. (Geiger-PTT)
W86-02117

CONSTRUCTION TECHNIQUES FOR REMEDIAL DESIGN AT A CONNECTICUT SUPERFUND SITE: A CASE STUDY,
Hart (Fred C.) Associates, Inc., New York.
For primary bibliographic entry see Field 5G.
W86-02118

PREDICTING LEACHATE GENERATION IN LANDFILLS: A NEW METHOD,
Anderson (James C.) Associates, Camden, NJ.
J. R. Gee.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 548-567, 4 fig 8 tab, 21 ref. C2521NASX.

Descriptors: *Landfills, *Lysimeters, *Leachates, *Percolation, *Mathematical equations, Models, Simulation analysis, Leaching, Soil water, Statistical analysis, Computer models, Model studies, Waste disposal.

A summary of part of a research effort to develop a more direct method of landfill percolation prediction based on the percolation process itself rather than on the processes surrounding it is presented. Factors were selected for measurement which could be easily measured in the field. They are: rainfall amount, initial soil moisture content, soil density, slope, and runoff. Using a specially designed rainfall simulator and lysimeters, laboratory testing of five different landfill cover soils were carried out. Rainfall simulator data was analyzed using the MINITAB statistical computer program. An extensive nuumber of linear equations were analyzed to find a good relationship between the variables selected. In addition to the equations generated, the Thornthwaite Water Balance, HELP and HSSWDS computer models were also used to predict leachate generation at Cell 1 of the Madison solid waste lysimeters from 1972 to 1975. Predicted values from both the physical and non-physical rainfall simulator models and their laboratory determined coefficients showed better accuracy than existing water balance methods on a monthly and yearly basis. (Geiger-PTT)
W86-02122

HAZARDOUS WASTE MANAGEMENT FOR THE 80'S.
Ann Arbor Science, Ann Arbor, MI. 1982. Edited by T. L. Sweeney, H. G. Bhatt, R. M. Sykes, and O. J. Sproul. 553 p.

Descriptors: *Waste disposal, *Waste management, *Groundwater pollution, *Industrial wastes, *Waste identification, *Landfills, On-site investigations, Cleanup operations, Legal aspects, Field tests, Groundwater, Environment, Pollutants, Aerial photography, Water, Leachates, Mathematical models.

A series of papers reflecting current work on critical issues in hazardous waste management (including groundwater and seepage; treatment, storage and disposal; site cleanup; and safety and legal considerations) is presented. A variety of industrial contaminants are considered, and many practical problems involved in disposal (particularly land disposal) are addressed. Site assessment, containiment and encapsulation of hazardous waste disposal sites, hazardous waste site cleanup, and remedial action for abandoned waste sites are among the topics covered. Groundwater monitoring, contamination and recovery are discussed. Several case histories are presented to illustrate the various topics. (Halterman-PTT)
W86-02219

CLASSIFICATION AND MANAGEMENT OF PROCESS WASTES FOR THE TENNESSEE SYNFUELS ASSOCIATES COAL-TO-GASOLINE FACILITY,
R. W. Rittmeyer, J. P. Fillo, D. P. Malik, A. J. Merritt, and J. P. Brennan.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 45-80, 4 fig, 7 tab, 9 ref.

Descriptors: *Industrial wastes, *Waste disposal, Waste identification, Solid wastes, Solid waste disposal, Land disposal, Landfills, Regulations.

A plant proposed by the Tennessee Synfuels Associates for the production of gasoline from locally available bituminous coal is described, and the development of an inventory, preliminary classifications, and management options for process wastes expected from the facility are reported. The features of the 1976 Resource Conservation and Recovery Act which apply to this plant are reviewed. For each plant operating area, the generated wastes, generation rate and schedule, potential hazard classification, and proposed management techniques for various wastes are presented in tabular form. A schematic for probable waste management techniques is included. The information represents best estimates base on current process design. The facility (50,000 barrels per day capacity) will generate approximately 4.6 million tons/year of raw wastes in five categories: coal-derived wastes (77%), organic wastes (4%), byproducts (4%), spent catalysts (0.06%), and other wastes (15%). In-process management will reduce the amount of wastes actually leaving process units to 2.4 million tons/year, 87% of which will be coal-derived. Hazardous wastes will be subjected to routine analysis and non-hazardous wastes will be analyzed at least annually. (Halterman-PTT)
W86-02220

DETERMINATION OF DISPOSAL SITES FOR PCB CONTAMINATED MATERIAL DREDGED FROM THE HUDSON RIVER BED,
Pirnie (Malcolm), Inc., Paramus, NJ.
J. S. Reed, and J. C. Henningson.
IN: Hazardous Waste Management for the 80's. Ann Arbor Science, Ann Arbor, MI, 1982. p 81-93, 2 fig, 2 tab, 6 ref.

Descriptors: *Dredging, *Spoil banks, *Waste disposal, Hudson River, Land disposal, Environment, Field tests, On-site investigations, Polychlorinated biphenyls.

The selection process used in locating a site for disposal of PCB-contaminated material obtained from two Hudson River dredging projects is described. The five steps in the approach are described in detail. The steps are: development of siting criteria; preparation of overlays using topographic maps as a base; delineation of specific sites within the environmentally acceptable 'windows'; conduction of preliminary field visits; and conduction of detailed field investigations. Public participation and response was also included in this study. The detailed field investigation of the preferred

site included soil borings, a resistivity survey, and test pit investigations. This approach resulted in a site which meets or exceeds both State and Federal standards. (Halterman-PTT)
W86-02221

ROLE OF THE ANALYTICAL LABORATORY IN HAZARDOUS WASTE MANAGEMENT,
Harmon Engineering and Testing, Auburn, AL.
V. K. Varma, B. B. Ferguson, and M. S. Shearon.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 115-141, 2 fig, 3 tab, 11 ref.

Descriptors: *Industrial wastes, *Waste disposal, *Waste identification, *Environment, Waste management, Groundwater, Laboratories, Regulations, Legal aspects.

Several aspects of the role of the analytical laboratory in hazardous waste management are addressed, including examination of selected analytical considerations, presentation of selected case studies, and guidelines for obtaining laboratory services. The functions of the analytical laboratory within the Hazardous Waste Management (HWM) system of the Resource Conservation and Recovery Act (RCRA) fall into three categories: waste identification; waste and waste constituent monitoring; and treatment, clean-up and other certifications. Programs which have been developed specifically for meeting the compliance objectives of the HWM system are described in detail. These programs include waste identification, delisting of waste sources and specific wastes, groundwater monitoring plans, and waste analysis plans. The analytical chemistry considerations discussed include sample collection and preservation, analytical interferences, instrumentation, and quality control. Three case studies illustrate the role of the analytical laboratory in the HWM system decision-making process. (Halterman-PTT)
W86-02222

REMEDIAL ACTION ALTERNATIVES FOR ABANDONED HAZARDOUS WASTE SITES,
For primary bibliographic entry see Field 5G.
W86-02225

SLURRY TRENCH CUTOFF WALLS FOR HAZARDOUS WASTE ISOLATION,
For primary bibliographic entry see Field 5G.
W86-02226

CLAY LINER PERMEABILITY - A PROBABILISTIC DESCRIPTION,
Carnegie-Mellon Univ., Pittsburgh, PA.
K. O. Harrop-Williams.
IN: Hazardous Waste Management fr the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 307-314, 2 fig, 13 ref.

Descriptors: *Landfills, *Waste disposal, *Permeability coefficients, *Mathematical models, Model studies, Liquid wastes, Solid wastes, Environment.

The primary criterion used in evaluating the suitability of hazardous waste landfills for containing hazardous waste is permeability, and many regulatory agencies have adopted regulations requiring clay-lined hazardous waste landfills to have a coefficient of permeability no greater than a fixed value. However, permeability is one of the most variable of engineering properties and its behavior is best described using probability theory. A model is developed to predict the uncertainty associated with specified permeability values. Using this model, it is possible to establish confidence levels associated with possible ranges of the coefficients of permeability of clay-lined hazardous waste landfills. The probability density function of the coefficient of permeability is derived from a microscope view of flow through soils. In developing this model, the permeant was assumed to be a neutral agent (e.g., water). However, as is usually done in clay-liner design, this model can be modified to include the effect of chemicals on the clay. (Halterman-PTT)
W86-02227

CONTAINMENT AND ENCAPSULATION OF HAZARDOUS WASTE DISPOSAL SITES,
A. A. Metry.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 315-342, 7 fig, 5 tab, 10 ref.

Descriptors: *Waste disposal, *Landfills, *Environmental engineering, Radioactive wastes, Solid wastes, Environmental effects, Computer models, Environment, Wastes.

State-of-the-art techniques for containment and encapsulation of hazardous waste disposal sites are discussed. Such techniques have been applied as remedial action for inactive hazardous waste disposal sites containing chemical, toxic and low-level radioactive materials. The use of computer simulation for optimization of design features is discussed, and techniques for evaluation of cover, liner and barriers are presented and illustrated. The case history presented is for a large site containing low-level radioactive waste, but can be applied to other types of hazardous waste. Components of the cover system are considered, with 18 cover types being evaluated based on 20 performance criteria. In a discussion of the function of the liner system, 12 materials are evaluated. It is concluded that it is preferred to utilize passive rather than active techniques for encapsulating waste-disposal sites. Multilayer cover systems, soil/clay liners, bentonite slurry walls and ion-exchange barriers represent the basic elements of remedial action that do not require perpetual postclosure operations. (Halterman-PTT)
W86-02228

ESTIMATES OF SEEPAGE THROUGH CLAY COVERS ON HAZARDOUS WASTE LANDFILLS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
S. J. Wright, and C. P. Miller.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 343-356, 4 fig, 2 tab, 13 ref.

Descriptors: *Waste disposal, *Landfills, *Linings, *Leachate, Model studies, Mathematical models, Wastes, Industrial wastes, Environment.

The importance of estimating the amount of leachate generated in a hazardous waste landfill is stressed, and several methods available for the estimate of leachate rates are described, along with their shortcomings. An alternative method, based on a numerical model and using a more mechanistic approach, is presented. The example is based on a hypothetical landfill, but with meteorlogical information from a specific location. Three conclusions can be reached. First, the leakage rates through the clay layer are greater than the saturated hydraulic conductivity which is often stated to be the case for fully saturated flow. Leakage rates of four or five times this value can be computed. Second, if the total potential leakage into the clay is of the same order of magnitude as the saturated hydraulic conductivity or less, the liner will accept all downward flow. And third, the thickness of the clay liner only affects the time that it takes for a significant amount of leakage to begin to enter the landfill and has little effect upon the seepage rates. (Halterman-PTT)
W86-02229

MUNICIPAL SOLID WASTE MANAGEMENT FACILITY LOCATION MAPPING: SUPPORT ACTIVITIES REPORT,
Texas Natural Resources Information System, Austin.
Report TNRIS-031, January 1983. 22 p, 5 fig, 2 tab, 2 ref, append.

Descriptors: *Texas, *Waste disposal, *Computer programs, *Waste management, *Solid waste disposal, *Waste dumps, Automation, Municipal wastes, Landfills, Composting, Permits, Maps, *Mapping.

The Texas Department of Health (TDH) was designated by the 'Solid Waste Disposal Act,' Article 4477-7, Vernon's Texas Civil Statutes, as the Texas agency responsible for providing standards for managing the collection, handling, storage, and disposal of municipal solid waste. TDH is empowered by the Act to require and issue permits authorizing and governing the operation and maintenance of sites used for the management (including disposal) of solid waste. The Department has for some time maintained automated records associated with each permit application and each permitted site. Although the geographic coordinates of each existing or proposed site were on the file, no systematic means was available for displaying the site locations by geographic coordinates as computer-generated maps. By including site location data in the TNRIS Geographic Information System (GIS), TDH can display the data along with a variety of other geographic information already included in the GIS. Data can be reproduced at any scale in any of eight available geographic projections. TNRIS System Central staff provided computer software to establish a GIS file which included the type, location, and status of each proposed or existing municipal solid waste management site. Plots of the data have been used by TDH for a variety of purposes including scheduling of public hearings and (in conjunction with maps showing physical and geological features and population) to identify areas of potential concern related to each site. (Author)
W86-02320

WET METHOD FOR EXCRETA DISPOSAL,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-02333

LOW-COST ALTERNATIVES TO SEWERAGE,
Cole and Co. Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W86-02334

EXCRETA REUSE OPTIONS: COMPOSTING AND BIOGAS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-02335

OXIDATION PONDS AND FISH CULTURE,
Cole and Co. Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W86-02336

SANITATION ASPECTS OF WATER SUPPLY AND EXCRETA DISPOSAL,
Ministry of Health, Lilongwe (Malawi).
W. G. Bomba.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 311-325, 5 fig, 2 tab, 9 ref.

Descriptors: *Sanitation, *Public health, *Waste disposal, *Water supply, *Developing countries, Water quality, Drinking water, Case studies, Water supply development, Water quality control, Water quality management, Pathogens, Infection, Human diseases, Social aspects.

The improvement of public health in developing countries can only arise through satisfactory systems of water supply, sanitation and health education. The role of health education in sanitation programs is highlighted using two case studies - a water study in Lesotho and latrinization program in Malawi. The principal human diseases that can be transmitted by water and their causative agents (bacteria, protozoa, viruses, and helminths) are reviewed. Many water-related diseases have more than one route of transmission. The ingestion of food or drink contaminated with feces, infection from contact with water, transmission from contact with soil, infection via insect vectors, and infection via meat are considered. Education programs had to be adopted in Malawi to encourage people to use latrines. Water contamination may take place when water is drawn from unprotected

sources, when drawn from taps into contaminated containers, or when storage containers inside the home are left uncovered. Coliform bacteria is usually used as an indicator of drinking water quality. The decision to condemn a certain water supply should be left to those who know the local circumstances and who are responsible for safeguarding the health of the community. (Geiger-PTT)
W86-02340

5F. Water Treatment and Quality Alteration

ZETA POTENTIAL STUDY OF THE WATER TREATMENT OF GEOTHERMAL BRINES,
Idaho National Engineering Lab., Idaho Falls.
P. M. Wikoff, and D. F. Suciu.
Available from the National Technical Information Service, Springfield, VA 22161 as DE-005910, Price codes: A03 in paper copy, A01 in microfiche. Report EGG-GTH-5673, November 1981. 27 p, 15 fig, 3 tab, 7 ref. DE-AC07-761D01570.

Descriptors: *Water treatment, *Cooling water, *Flocculation, Corrosion control, Geothermal studies, Zeta potential, Silica, Phosphates, Ferrous sulfate, Polymers, Adsorption, Magnesium oxide, Lime, Brines.

Zeta potential studies on geothermal cooling water were performed on the silica reduction system and the phosphate reduction system. In the silica reduction system, data suggested that adsorption occurred between the magnesium hydroxide formed in solution and the silica. Addition of calcium ion caused a bridging type of adsorption between the silica-magnesium hydroxide particles. The optimum magnesium oxide concentration, added as magnesium chloride, was 150-200 ppm MgO. Optimum pH, adjusted with lime, was 10.2. The best polymer was Betz 1125L at a dose of 1 ppm. An excess of polymer (8 ppm or greater) left more silica in solution. In the phosphate reduction system the optimum iron concentration was 20-30 ppm added as ferrous sulfate. Optimum pH, adjusted with lime, was 9.2 Betz 1195, a cationic polymer, produced the largest, best-selling flocs at an optimum concentration of 2-4 ppm. Since the phosphate studies were done on domestic water, further research is needed to account for the zinc sulfate or dispersants normally present in blowdown water. (Cassar-PTT)
W86-01987

RATIONAL PROCEDURE FOR ESTABLISHING DISCHARGE CONCENTRATION LIMITS IN MUNICIPAL SEWER USE ORDINANCES,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5D.
W86-02103

TREATMENT ALTERNATIVES FOR GROUNDWATER CONTAMINATION,
Montgomery (James M.), Inc., Reston, VA.
A. R. Appleton, and M. Kavannaugh.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 351-383, 6 fig, 10 tab, 33 ref.

Descriptors: *Aeration, *Groundwater pollution, *Activated carbon, *Design criteria, *Case studies, Water treatment, Adsorption, Organic compounds, Water quality control, Odor, Taste, Water pollution sources, Cost analysis.

Several options are available for the removal or reduction of carcinogenic compounds from groundwater. These include: source control, blending with uncontaminated sources, development of new sources, treatment of contaminated sources, and point-of-use treatment. Physicochemical parameters of organic compounds are useful in predicting their behavior in the environment and removal efficiencies in treatment processes. Aeration processes, particularly packed tower air stripping, may be effective in treating contaminated groundwaters. Similarly, the octanol:water partition coefficient is useful in predicting the effectiveness of granular activated carbon adsorption for removal of specific compounds. More accurate cost estimates for CAC adsorption, as well as aeration, require full-scale design criteria obtained through site specific pilot-scale studies. Two case studies from Southern California are presented to illustrate full-scale applications of treatment processes for the removal of organic compounds from groundwaters. The Valley County Water District used an air stripping system for the removal of trichloroethane and the City of La Habra used a packed tower to alleviate taste and odor problems. (Geiger-PTT)
W86-02110

WATER CHLORINATION: ENVIRONMENTAL IMPACT AND HEALTH EFFECTS; VOLUME 4, BOOK 1: CHEMISTRY AND WATER TREATMENT,
Proceedings of the Fourth Conference on Water Chlorination: Environmental Impact and Health Effects, Pacific Grove, California, October 18-23, 1981. Ann Arbor Science, Ann Arbor, MI. 1983. 2 v. (1491 p.) Edited by Robert L. Jolley, Wiliam A. Brungs, Joseph A. Cotruvo, Robert B. Cumming, and Jack S. Mattice.

Descriptors: Fate of pollutants, *Water treatment, *Chlorination, *Pollutant identification, *Water analysis, Chloramines, Bromination, Organic compounds, Trihalomethanes, Chlorinated hydrocarbons, Chlorine demand, Residual chlorine, Wastewater treatment, Wastewater analysis, Kinetics, Chemical reactions, Activated carbon, Humic acids, Fulvic acids, Oxidation, Organic matter, Cooling water, Seawater, Disinfection, Chromatography, Trace levels.

This volume concerns the chemistry of water treatment, emphasizing the fate and effects of chlorine. Section I describes the chemistry of nitrogenous and other compounds, including the products of halogens with ammonia, amino acids, proteins, polynuclear aromatic hydrocarbons, and lipids. Section II, the chemistry of chlorine demand, considers the products formed when chlorine and bromine react with aquatic humic materials and other organic matter to form trihalomethanes and other halogenated compounds. Section III discusses the fate of chlorine and the formation of halogenated organic compounds in cooling water, drinking water, wastewater, and municipal landfill leachates. The alternative disinfectants, hydrogen peroxide and ozone, are evaluated. Analytical methods are presented in Section IV and V. They include methods for analyzing halogenated organic mixtures as well as for determing chloramines, residual chlorine, and residual oxidants attrace levels. Several systems for continuous monitoring are described. (Cassar-PTT)
W86-02135

REVIEW OF THE CHEMISTRY AND ENVIRONMENTAL FATE OF REACTIVE OXIDANT SPECIES IN CHLORINATED WATER,
Oak Ridge National Lab., TN.
R. L. Jolley, and J. H. Carpenter.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 3-47, 4 fig, 7 tab, 118 ref. EPA079-D-X0789.

Descriptors: *Water treatment, *Literature reviews, *Chlorination, *Bromination, *Oxidation, Chemical reactions, Organic compounds, Chloramines, Bromamines, Trihalomethanes, Wastewater treatment, Hypochlorous acid, Hypobromous acid, Iodine, Chlorine demand, Fate of pollutants, Ammonia, Nitrogen compounds.

This review concerns the chemistry of chlorine in wastewaters and in natural waters as it pertains to the formation, degradation, and reaction products of free and combined oxidants. Chlorine hydrolyzes very rapidly in water to form hypochlorous acid, which upon dissociation forms hypochlorite ion. As pH increases, the hypochlorite ion becomes more dominant than the undissociated acid. Chlorine added to water containing bromide yields hypobromous acid and chloride ion. Dissociation of hypobromous acid forms hypobromite ion, which is dominant at higher pH. Chlorination of iodine-containing water produces molecular iodine and chloride. Ammonia combines with hypohalous acids to form mono- and dihalamines as well as nitrogen tribromide and trichloride. Monochloramine and dibromamine are common constituents of chlorinated and brominated wastewaters. Although monochloramine is a less effective chlorinating agent than hypochlorous acid, it minimizes formation of trihalomethanes during water treatment. Chlorine or bromine plus amino acids or other nitrogen-containing organics yields organic chloramines or bromamines. Knowledge of the organic halamines and their reaction products in natural water is limited. Bromochloramines can form in salt water systems. Chlorine demand, the difference between chlorine dosage applied to water and the measured available chlorine, is a result of inorganic oxidation and reactions with organic matter. Disproportionation of hypohalous acids (e.g., formation of chlorate and chloride) takes place at basic pH. Photochemical or catalytic influence cause hypohalous acids to decompose, yielding oxygen. Free available chlorine also reacts with organic matter to form a complex mixture of organohalides. (Cassar-PTT)
W86-02136

MODELING OF REACTIONS BETWEEN AQUEOUS CHLORINE AND NITROGENOUS COMPOUNDS,
Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
For primary bibliographic entry see Field 5D.
W86-02137

CRITICAL REVIEW OF KINETIC AND THERMODYNAMIC CONSTANTS FOR THE AQUEOUS CHLORINE-AMMONIA SYSTEM,
Harvard Univ., Cambridge, MA. Dept. of Applied Science.
J. C. Morris, and R. A. Isaac.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 49-62, 4 fig. 2 tab, 19 ref. DAMD 17-77-C-7051.

Descriptors: *Water treatment, *Chlorination, *Chemical reactions, *Nitrogen compounds, Chloramines, Hydrolysis, Kinetics, Thermodynamics.

Tables list a complete summary of the kinetic and equilibrium constants and the derived thermodynamic quantities for reactions of the aqueous chlorine-ammonia system. Reaction systems considered are (1) monochloramine + water yield ammonia + hypochlorous acid, (2) dichloramine + water yield monochloramine + hypochlorous acid, (3) nitrogren trichloride + water yield dichloramine + hypochlorous acid, and (4) disproportionation of monochloramine to yield ammonia and dichloramine. Some of the values are less accurate than desired; some are based on relatively insecure assumptions. However, trends are seen in reactivity, degree of phydrolysis, and endothermicity. (Cassar-PTT)
W86-02138

ULTRAVIOLET ABSORPTION SPECTRA OF BROMOCHLORAMINE AND DIBROMOCHLORAMINE IN ETHER,
Tennessee Univ., Knoxville. Dept. of Chemistry.
W. R. Haag, and R. L. Jolley.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983, p 77-83, 2 fig, 10 ref.

Descriptors: *Water treatment, *Chlorination, Chloramines, Bromochloramines, Spectrometry.

Ultraviolet absorption spectra were determined for bromochloramine and dibromochloramine in ether. These compounds were prepared by mixing hypobromite solution with monochloramine. At an HOBr/NH2C1 molar ratio <0.4 two new peaks at 220 and 333 nm were always observed on top of

the monochloramine spectrum, and the increase in absorbance between successive experiments was proportional to the difference in the amount of bromine added, suggesting that a single new compound (NHBrC1) had been formed. Increasing the HOBr/NH2C1 molar ratio above 0.5 produced spectra which indicated the formation of NBr2C1. Based on the ether spectra, the NBrC12 peak in water, at 230 nm with maximum extinction coefficient of about 7000. Possible reasons that these compounds have not been detected in chlorinated saline water are (1) overlapping absorption bands caused by mixtures of halamines and (2) rapid decomposition of the bromochloramines. (Cassar-PTT)
W86-02139

DIHALOACETONITRILES IN CHLORINATED NATURAL WATERS,
Florida Atlantic Univ., Boca Raton. Dept. of Chemistry.
T. I. Bieber, and M. L. Trehy.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 85-96, 3 tab, 30 ref.

Descriptors: *Water treatment, *Chlorination, Dihaloacetonitriles, Chlorinated hydrocarbons, Nitrogen compounds, Amino acids, Dichloroacetonitrile, Dibromoacetonitrile, Proteins, Trihalomethanes, Activated carbon, Absorption, Chloramine.

Dichloroacetonitrile, dibromoacetonitrile, and bromochloroacetonitrile were identified in chlorinated natural waters in south Floriday. Thes result from chlorination of proteinaceous materials such as certain amino acids and polypeptides. Aspartic acid and aspartyl residues are especially prolific dihaloacetonitrile (DHAN) producers. Chlorination of lake water at 6 and 20 mg/liter chlorine for 15 min showed that increasing concentrations of DHANs were formed with increasing contact time. Levels of DHANs were also higher at the 20 mg/liter level. For example, at 20 mg/liter and 15 min contact time concentrations in ppb were as follows: dichloroacetonitrile, 5.2, and bromochloroacetonitrile, 0.4. Likewise, the concentrations of trihalomethanes (THMs) increased with dose and contact time. Levels of total THMs produced in lake water samples at 20 mg/liter chlorine and 15 min contact time were 182 ppb. Activated carbon can be used to remove DHAN precursors, but the process is energy-intensive, costly, and has many variables. Lime treatment increases water pH, shortens the half-lives of the DHANs, but increases the levels of THMs formed. Use of chloramine as a disinfectant maintains low levels of DHAN. (Cassar-PTT)
W86-02140

PRODUCT DISTRIBUTION AND RELATIVE RATES OF REACTION OF AQUEOUS CHLORINE AND CHLORINE DIOXIDE WITH POLYNUCLEAR AROMATIC HYDROCARBONS,
Minnesota Univ.-Duluth. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-02145

CHLORINE DEMAND: STUDIES CONCERNING ITS CHEMICAL BASIS,
Maryland Univ., College Park. Dept. of Chemistry.
G. R. Helz, D. A. Dotson, and A. C. Sigleo.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983, p 181-190, 2 fig, 2 tab, 15 ref.

Descriptors: Fate of pollutants, *Water treatment, *Chlorination, *Organic matter, *Oxidation, Proteins, Amino acids, Chlorine demand, *Wastewater treatment, Waste treatment.

The oxidizing agents assayed by standard chlorine analyses are known to disappear on time scales ranging from minutes to days, depending on treatment conditions and water quality but the reactions responsible for this disappearance are poorly known. An assortment of evidence points to reactions involving organic matter as major chlorine consumers, but it is generally agreed that formation of halocarbons is minor. Experiments in which river water was treated with about 150 microM of NaOC1 (about 10 ppm C12) produced about 35 microM of carbon dioxide. However, oxidation of organic matter to carbon dioxide in these experiments definitely cannot account for all the chlorine decay and probably accounts for only about half of it. Investigation of the effect of chlorination on protein macromolecules showed a general loss of protein amino acids after chlorination, as well as a more pronounced loss of the specific amino acids that possess reactive side groups (lysine, histidine, arginine, methionine, and tyrosine). Because only two reaction products were observed during amino acid analysis by liquid chromatography and gas chromatography, it is concluded that most off the reactive amino acids are substantially altered or totally oxidized by chlorination. The general loss of protein could be caused by scission of the protein chain at sites occupied by reactive amino acids, yielding polymer fragments too small in some cases to be recovered by ultrafiltration. (Author)
W86-02147

CHLORINATION PRODUCTS FROM AQUATIC HUMIC MATERIAL AT NEUTRAL PH,
North Carolina Univ. at Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 5B.
W86-02148

FULVIC ACID AND CHLORINATED FULVIC ACID IN WATER AND SEDIMENT: HPLC FRACTIONATION AND SPECTROSCOPIC CHARACTERIZATION,
North Texas State Univ., Denton. Inst. of Applied Sciences.
For primary bibliographic entry see Field 5B.
W86-02149

ORGANIC REACTION PRODUCTS OF CHLORINE DIOXIDE AND NATURAL AQUATIC FULVIC ACIDS,
North Carolina Univ. at Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 5B.
W86-02150

INFLUENCE OF AQUATIC HUMIC SUBSTANCE PROPERTIES ON TRIHALOMETHANE POTENTIAL,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W86-02151

EMPIRICAL MODEL FOR PREDICTING CHLOROFORM FORMATION FROM HUMIC AND FULVIC ACIDS,
For primary bibliographic entry see Field 5B.
W86-02152

FORMATION OF TRIHALOMETHANES FROM THE HALOGENATION OF 1,3-DIHYDROXYBENZENES IN DILUTE AQUEOUS SOLUTION: SYNTHESIS OF 2-13 C-RESORCINOL AND ITS REACTION WITH CHLORINE AND BROMINE,
California Inst. of Tech., Pasadena. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W86-02153

KINETICS AND MECHANISM OF HALOFORM FORMATION: CHLOROFORM FORMATION FROM TRICHLOROACETONE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5B.
W86-02154

QUANTITATIVE EFFECTS OF BROMINE ON THE FORMATION AND DISTRIBUTION OF TRIHALOMETHANES IN GROUNDWATER WITH A HIGH ORGANIC CONTENT,
Florida International Univ., Miami. Drinking Water Quality Research Center.
For primary bibliographic entry see Field 5B.
W86-02155

FORMATION OF BROMINATED TRIHALOMETHANES: EXTENT AND KINETICS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-02156

BROMOFORM PRODUCTION IN TROPICAL OPEN-OCEAN WATERS: OCEAN THERMAL ENERGY CONVERSION CHLORINATION,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5B.
W86-02157

DISPERSION OF CHLORINE AT SEVEN SOUTHERN CALIFORNIA COASTAL GENERATING STATIONS,
Southern California Edison Co., Rosemead.
For primary bibliographic entry see Field 5B.
W86-02158

MODEL FOR PREDICTING CHLORINE CONCENTRATION WITHIN MARINE COOLING CIRCUITS AND ITS DISSIPATION AT OUTFALLS,
Central Electricity Generating Board, Fawley (England). Marine Biological Unit.
For primary bibliographic entry see Field 5B.
W86-02159

HALOGENATED ORGANIC STUDY AT SELECTED TENNESSEE VALLEY AUTHORITY FOSSIL-FUELED POWER PLANTS,
Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 5B.
W86-02161

ORGANOHALOGENS IN CHLORINATED COOLING WATERS DISCHARGED FROM NUCLEAR POWER STATIONS,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W86-02162

ATMOSPHERIC EMISSIONS FROM ELECTRIC POWER PLANT COOLING SYSTEMS,
SRI International, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W86-02163

HYDROGEN PEROXIDE - A REAL ALTERNATIVE TO CHLORINE IN WATER TREATMENT,
North Surrey Water Co., Staines (England).
For primary bibliographic entry see Field 5B.
W86-02164

EVALUATION OF OZONE PRETREATMENT OF SURFACE WATERS PRIOR TO CHLORINATION FOR REDUCTION IN TRIHALOMETHANE FORMATION,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
J. N. Veenstra, J. B. Barber, and P. A. Khan.
IN: Water Chlorination: Environmental Impact and Helath Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 455-465, 7 fig, 1 tab, 10 ref.

Descriptors: *Water treatment, *Ozonation, Chlorination, Trihalomethanes, Organic carbon, Chlorinated hydrocarbons, Kaw Lake, Oklahoma, Disinfection.

Ozone pretreatment of Kaw Lake (Oklahoma) water before chlorination affected reductions in

the total organic carbon (TOC) and trihalomethane(THM)-forming potential. With mean absorbed ozone dosage of 2.9 +- 1.1 mg/liter (+-1 SD), the mean TOC reduction was 10.3 + 23.0% (+-1 SD). The TOC chromatgrams for all samples showed the predominance of one peak for the TOC in the molecular weight fraction of 1000 to 5000. Seasonal shifts in TOC patterns occurred as illustrated by the change in percentage of TOC in the <4000 apparent molecular weight group was found in the ozonated samples than in the raw water samples. This difference, which varied from 5 to 8%, reflected the effect of ozonation. A seasonal shift toward bromoform in the total trihalomethane production was observed, and ozonation accentuated the shift toward bromoform. Ozonation caused a decrease in the yields of allfour trihalomethanes. For Kaw Lake, water ozonation caused a greater reduction in total trihalomethanes than in TOC. Possible alteration of the precursors by ozonation could make them less amendable to trihalomethane formation. Preliminary results of this study have shown preozonation to have a limited effect in reducing the concentration of the more brominated trihalomethanes. The study is continuing because the potential overall effects of preozonation have not been fully evaluated. (Author)
W86-02167

INFLUENCE OF PRECHLORINATION ON THE AMOUNT AND TOXICITY OF MICROPOLLUTANTS EXTRACTED FROM WATER AT THE MORSANG PLANT,
Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
For primary bibliographic entry see Field 5B.
W86-02168

WATER TREATMENT PLANT DESIGN FOR THE PRACTICING ENGINEER.
Ann Arbor Science, Ann Arbor, MI. 1982. Edited by Robert L. Sanks. 845 p.

Descriptors: *Water treatment, *Water treatment facilities, *Chemical treatment, Drinking water, Potable water, Coagulation, Flocculation, Filtration, Sedimentation, Water analysis.

Various aspects of water treatment plant design are presented to assist consulting engineers. Specific areas of discussion include effects of federal regulations on water treatment design, public health aspects of water supplies, treatment processes (coagulation, sedimentation, flocculation, filtration, suspended solids removal, softening, ion exchange, sludge removal), chemical handling and feeding, equipment design, package water treatment plants, corrosion control, automated operation, pump station design, instrumentation, cost estimation techniques, operation and maintenance manuals, and operator training. (Halterman-PTT)
W86-02188

EFFECTS OF FEDERAL REGULATIONS ON WATER TREATMENT PLANT DESIGN,
Environmental Protection Agency, Denver, CO. Region VIII.
P. E. Hoffbuhr, and D. R. Chaussee.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 1-15, 8 tab, 8 ref.

Descriptors: *Water treatment, *Chemical treatment, Water treatment facilities, Legal aspects, Regulations, Drinking water, Potable water.

Various aspects of the Safe Drinking Water Act are discussed, with emphasis on maximum contaminant levels, and design consideration, including water source treatment selection. The focus of the treatment selection discussion is inorganic and organic chemical removal, turbidity, microbiological contaminants and radiological chemicals. The greatest difficulty will be for small communities to meet the requirements of the new law. Since cost effective water treatment processes for small water systems have never been fully developed, research in this area is badly needed. (Halterman-PTT)
W86-02189

PUBLIC HEALTH ASPECTS OF WATER SUPPLIES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5C.
W86-02190

PREDESIGN STUDIES,
Montgomery (James M.), Inc., Pasadena, CA.
R. R. Trussell.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 37-64, 13 fig, 4 tab, 36 ref.

Descriptors: *Water treatment, *Drinking water, Potable water, Water analysis, Treated water, Filtration, Flocculation, Water treatment facilities, Turbidity.

Methods for establishing treatment requirements for specific water supplies, prior to the designing of a treatment plant, are detailed. The treatment processes of major concern are removal of turbidity, iron, manganese, color and H2S; treatment for tastes and odors; softening; and disinfection. To assist the design engineer, applicable water quality standards and their meaning are discussed. Methods for evaluating water sources are reviewed, with special emphasis on meaningful methods of data analysis. Appropriate bench-scale tests are discussed, emphasizing evaluation of jar test data (turbidity topogram) and direct filtration studies. Pilot studies are discussed in detail, including comments on flocculation, sedimentation and filtration. (Halterman-PTT)
W86-02191

COAGULATION,
North Carolina Univ. at Charlotte. Dept. of Environmental Sciences and Engineering.
C. R. O'Melia.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 65-81, 4 fig, 19 ref.

Descriptors: *Water treatment, *Coagulation, Flocculation, Water treatment facilities, Aluminum sulfate, Color removal, Turbidity, Pollutants.

Coagulation, the process for combining small particles into larger aggregates, is an essential component of accepted water treatment practice in which coagulation, sedimentation and filtration processes are combined in a series to remove particulates from water. The coagulation process, including destabilization and mixing, is outlined. The materials used for destabilization are described. They include hydrolyzing metal ions (primarily aluminum), synthetic polymers, and coagulant aids (such as activated silic). Some guidelines for proper selection of these materials are provided. Finally, rapid mix and flocculation tanks are discussed. Guidelines for their proper use are provided. (Halterman-PTT)
W86-02192

SLUDGE DISPOSAL AND THE A.P. BLACK PROCESS,
Gainesville-Alachua County Regional Electric Water and Sewer Utilities Board, FL.
A. T. DuBose.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 83-103, 2 fig, 6 tab, 10 ref.

Descriptors: *Water treatment, *Chemical treatment, *Sludge utilization, Water treatment facilities, Turbidity, Flocculation, Water analysis, Sludge disposal, Sludge thickening.

The A.P. Black process for sludge removal entails pumping thickened sludge, produced from the lime-softening of hard, turbid or colored water, to a series of sludge carbonation cells where it is mixed with scrubbed kiln gas containing 20% CO2. The magnesium hydroxide is dissolved from calcium carbonate and turbidity factors. This slurry passes to a thickener from which clear supernatant containing soluble magnesium bicarbonate overflows and passes to a heat exchange unit and is warmed to 40 degrees C. After stirring, the precipitation of magnesium carbonate as the trihydrate is rapid and complete in 90 seconds. The turbidity factors are then removed by froth flotation, and the purified CaCO3 is calcinated to a high quality quicklime. The economics of this process are discussed and the application of this method under varying conditions is described. (Halterman-PTT)
W86-02193

FLOTATION PROCESS USED FOR CALCIUM CARBONATE RECOVERY FROM WATER TREATMENT SLUDGES,
Dawson Metallurgical Labs., Inc., Murray, UT.
H. A. Dawson.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 105-124, 6 fig, 6 tab, 9 ref.

Descriptors: *Water treatment, *Chemical treatment, *Froth flotation, Flotation, Treated water, Flocculation, Turbidity, Coagulation, Chemical coagulation, Calcium carbonate.

Froth flotation is a physico-chemical method for separating types of minerals or compounds present as discrete particles in an aqueous slurry. The history, mechanics of action, and the process are described. Results from tests conducted at several plants indicate that this process is relatively simple, easily controlled, and practical for the recovery of magnesium carbonate in large water treatment plants. The magnesium carbonate process is applicable for coagulation in the smallest plants. The recovery of magnesium carbonate, however, should be limited to plants that require at lest 0.9 ton of coagulant per day. (Halterman-PTT)
W86-02194

DESIGN OF RAPID MIX UNITS,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. Amirtharajah.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 131-147, 3 fig, 3 tab, 23 ref.

Descriptors: *Water treatment, *Chemical treatment, Flocculation, Treated water, Turbidity, Coagulation, Aluminum sulfate, Alum.

The rapid mix unit is often the first step in a water treatment process train, and provides the hardware necessary for the initial stages of the coagulation process. Some theoretical considerations for the rapid mixing operation are outlined, and summaries of the available alternatives in design are presented. Data needed for optimal design include analysis of best and worst raw water conditions, minimum and maximum flow rates, and typical jar test results of all water samples. The location of the rapid mix units must be close to the coagulant feed tanks to minimize clogging. Furthermore, the alum solution lines should be able to feed 5% or less into the raw water. (Halterman-PTT)
W86-02195

SEDIMENTATION,
Walker Engineer, Aurora, IL.
J. D. Walker.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 149--182, 9 fig, 4 tab, 8 ref.

Descriptors: *Water treatment, *Chemical treatment, Flocculation, Treated water, Turbidity, Coagulation, Aluminum sulfate, Alum, Sludge, Sludge disposal.

Sedimentation of flocculent solids to produce a clear effluent can be accomplished in several ways. The most economical and easily operated unit for this process is a well-designed clarifier basin, equipped with a sludge scraper and underflow control system. Solids contact systems, with a combination of solids return, high-rate mixing, floc aggregation, and circumferential vertical rise clarification, are also important considerations. Floc preparation before sedimentation should consist of

instant blending, rapid mixing floc aggregation. The newer high-rate settlers such as inclined tube or plate modules also warrant consideration, especially for small flows. Furthermore, conservative surface-loading rate parameters work well for small flow systems. (Halterman-PTT)
W86-02196

SLUDGE DISPOSAL,
Alvord, Burdick and Howson, Chicago, IL.
L. R. Howson.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 183-193, 2 fig, 8 ref.

Descriptors: *Sludge, *Sludge disposal, *Water treatment, *Sludge lagoons, Flocculation, Coagulation, Aluminum sulfate, Alum, Sludge thickening, Sludge solids.

Waterworks sludge is the suspended solid material (sand, silt, clay and algae) present in raw water plus the precipitated chemicals added to facilitate separation of suspended solids. Sludge is usually removed by a variety of methods, including backwashing, followed by deposition in lagoons. The use of lagoons is the most economical means of sludge removal, especially in small treatment plants. The costs of such methods as pressing and centrifugation usually exceeds the costs of lagoons. (Halterman-PTT)
W86-02197

DESIGN OF FLOCCULATION SYSTEMS,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. Amirtharajah.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 195-229, 8 fig, 3 tab, 38 ref.

Descriptors: *Water treatment, Flocculation, Chemical treatment, Turbidity, Chemical coagulation, Treated water, Aluminum sulfate, Clarifiers, Filtration.

The flocculation stage in water treatment is the aggregation or growth of the destabilized colloidal suspension. Two major mechanisms are identified: perikinesis (aggregation resulting from random thermal motion and significant for particles less than 2 microns); and orthokinesis (induced by velocity gradients in the fluid). The available kinetic models of the flocculation process are described, and the design of mechanical flocculators and sludge blanket clarifiers are discussed. (Halterman-PTT)
W86-02198

GRANULAR-MEDIA DEEP-BED FILTRATION,
Iowa State Univ., Ames. Dept. of Civil Engineering.
E. R. Baumann.
In: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 231-281, 25 fig, 6 tab, 42 ref.

Descriptors: *Water treatment, *Filtration, Drinking water, Potable water, Trace metals, Bacterial analysis, Metals, Treated water.

Deep-bed granular-media filters find widespread use in potable water treatment for the removal of suspended solids in a variety of applications, including iron and manganese precipitates removed from ground water supplies; removal of softening precipitate carry-over from lime-soda ash softening of ground or surface water supplies; removal of floc carry-over resulting from coagulation-flocculation-sedimentation of surface waters; and removal of microorganisms. Currently accepted technology, the hudraulics of flow in filters, filtered water quality considerations, filter control methods, and filter media are discussed in detail. (Halterman-PTT)
W86-02199

SUSPENDED SOLIDS REMOVAL,
Permutit Co., Inc., Paramus, NJ.
R. T. O'Connell.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 283-298, 4 fig, 1 tab, 9 ref.

Descriptors: *Water treatment, *Suspended solids, Flocculation, Chemical treatment, Turbidity, Chemical coagulation, Treated water, Aluminum sulfate, Clarifiers, Filtration.

Ideally, a water treatment plant effluent should contain less than one turbidity unit. To attain this quality, a water treatment plant must be equipped with the proper unit process to remove suspended solids. The various compounds used for chemical coagulation are reviewed. Alum is the most widely used material. Ferrous sulfate and ferric sulfate are commonly used when a wide range of pH exists. The use of Bentonite clay, powdered activated carbon and polymers for aiding coagulation are described. Solids contact-sludge blanket units and filtration are also discussed. The estimated costs for capital equipment, including solids contact units, gravity filters, chemical feeds and controls are provided. (Halterman-PTT)
W86-02200

ADVANCED TECHNIQUES FOR SUSPENDED SOLIDS REMOVAL,
Neptune Microfloc, Inc., Corvallis, OR.
W. R. Conley, and S. P. Hansen.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 299-312, 9 fig, 2 tab, 10 ref.

Descriptors: *Water treatment, *Suspended solids, Flocculation, Chemical treatment, Turbidity, Chemical coagulation, Treated water, Aluminum sulfate, Clarifiers, Filtration.

Improved suspended solids removal, at a low cost, can best be achieved by precisely controlling coagulation. Advanced technology for doing so includes the use of a coagulant control center which continuously monitors coagulation conditions and alerts the operator to any changes. High-rate treatments (tube settlers, and mixed media filters) also help improve the system by reducing costs. The combination of these two modifications provides superior suspended solids removal at capitol costs lower than those of conventional water treatment plants. (Halterman-PTT)
W86-02201

PRECOAT FILTRATION,
Iowa State Univ., Ames. Dept. of Civil Engineering.
E. R. Baumann.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 313-370, 34 fig, 11 tab, 18 ref.

Descriptors: *Water treatment, *Suspended solids, Flocculation, Chemical treatment, Turbidity, Chemical coagulation, Treated water, Aluminum sulfate, Clarifiers, Filtration.

Precoat filtration, employing thin layer (3-5 mm) of filter media, requires three steps: a precoating operation, a filtering step, and a backwashing operation. This effective filtering procedure results in the loss of filter media after each run because it is quite difficult to separate the filter media from the solids that were removed. The entire operation is described, along with guidelines for selection of filter types, filter media, and filter media coatings. Various applications for precoat filtering are provided, including budgetary constraints, large seasonal variation in demand, and systems needing emergency or standby service. Optimal plant designs for precoat filtering are discussed. (Halterman-PTT)
W86-02202

DESIGN AND APPLICATION OF POTABLE WATER CHLORINATION SYSTEMS,
G. C. White.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 371-395, 1 fig, 10 ref.

Descriptors: *Water treatment, *Drinking water, *Chlorination, *Chlorine, Potable water, Bacterial analysis, Wastewater treatment, Residual chlorine.

The information necessary for the design of a chlorination system is provided, and the objectives of chlorination and its many uses in water treatment are outlined, and the means of achieving these objectives are discussed. Chlorination has historically been a method of choice for disinfection, taste and odor control, algal growth prevention, slime prevention, removal of iron and manganese, and organic color bleaching. The benefits of chlorination with hypochlorinators and gas chlorinators are compared. Injector systems, diffusers, mixing devices and safety equipment are discussed. (Halterman-PTT)
W86-02203

PUMP STATIONS,
Black and Veatch, Kansas City, MO.
J. R. Wright.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 397-414, 7 fig, 1 tab, 2 ref.

Descriptors: *Water treatment, *Water treatment facilities, *Pumping, Pumping plants, Pumping tests, Pumps, Drinking water, Potable water.

Since water must be pumped either from the source of supply to the treatment works, or from the treatment works into the delivery system, or both, the pumping facilities must be consistent with the treatment plant design concepts. General considerations to be made are structural, architectural, and the layout of the equipment. Pump selection is based on a variety of factors, including pump design, pump control systems, drive systems (gasoline, gas, diesel, electric), cavitation tendency, sump design, piping, and valves. The important specification criteria for pumping stations and some data on costs of pumping stations are provided. (Halterman-PTT)
W86-02204

PACKAGE WATER TREATMENT PLANTS,
Culp/Wesner/Culp, Shingle Springs, CA.
S. P. Hansen, and W. R. Conley.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 415-434, 7 fig, 4 tab, 6 ref.

Descriptors: *Water treatment, *Drinking water, *Water treatment facilities, Potable water, Coagulation, Flocculation, Filtration, Settling tanks, Sedimentation.

The package water treatment plant has become established as a practical and economic solution for providing treated water for small communities. The historical problems associated with these systems have been overcome with recent developments in flocculation, clarification, and filtration. Features that are available to continuously monitor filtered water turbidity and to prevent the introduction of poor quality water into the distribution system are discussed. Because of the economics of their construction, ease of operation and maintenance, and reliability, package plants should be carefully considered for flows of less than 5 mgd. (Halterman-PTT)
W86-02205

PACKAGE WATER TREATMENT EQUIPMENT,
Permutit Co., Inc., Paramus, NJ.
R. T. O'Connell.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 435-445, 5 fig, 2 tab.

Descriptors: *Water treatment, *Drinking water, *Water treatment facilities, Potable water, Coagulation, Flocculation, Filtration, Settling tanks, Sedimentation.

Package-type water treatment equipment (preassembled, modular treatment units) for removal of suspended solids are discussed, and examples of

treatment systems are detailed. The sludge blanket clarifiers, with horizontally mounted agitators, are well suited for the package-type unit concept because they are small, the internal parts can be readily fabricated, and the units require no welding. Steel-shell cylindrical gravity filters can be shipped partially preassembled. The two major types in use are the automatic valveless gravity filter and the steel shell, conventional style gravity filters. Two examples of system development are diagramed, showing raw water intake, chemical dosing for coagulation, agitation, and sludge filtration. Differences in the systems, with regard to filtration, are discussed. (Halterman-PTT)
W86-02206

INSTRUMENTATION FOR AUTOMATIC OPERATION,
R. H. Babcock.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 447-459, 2 fig, 3 tab, 9 ref.

Descriptors: *Water treatment, *Chemical treatment, *Water treatment facilities, Drinking water, Potablewater, Water analysis, Turbidity, Pollutants, Hydrogen ion concentration, Residual chlorine.

Automatic treatment systems have instrumentation that must control critical tasks, minimize tedious repetitive tasks, and provide a tool for process supervision. Critical areas are measurement of flow and level; analytical measurement and control (pH, turbidity, chlorine residual, fluoride and hardness); alarm systems; and the modulation of controls. The automatic control of treatment systems is becoming a major factor in the design of modern systems. (Halterman-PTT)
W86-02207

POTASSIUM PERMANGANATE FOR IRON AND MANGANESE REMOVAL AND TASTE AND ODOR CONTROL,
Carus Chemical Co., La Salle, IL.
K. J. Ficek.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 461-479, 10 fig, 2 tab, 20 ref.

Descriptors: *Water treatment, *Chemical treatment, *Drinking water, Potable water, Taste, Odor Control, Odors, Potassium permanganate, Chlorine.

Potassium permanganate can be used effectively and economically to reduce taste and odors and to oxidize iron and manganese. Because it is an oxidizing agent, potassium permanganate application prior to chlorination reduces the chlorine requirement. It can be used with other water treatment chemicals, such as carbon, to improve water quality. The normal dosage levels of potassium permanganate range from 0.5 to 2.5 mg/l, but higher dosages may be required for more highly contaminated waters. Finally, potassium permanganate is safe and easy to handle. (Halterman-PTT)
W86-02208

ACTIVATED CARBON FOR TASTE AND ODOR CONTROL,
Westvaco Corp., Covington, VA. Carbon Dept.
B. H. Kornegay.
IN: Water Treatment Plant Designfor the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 481-496, 12 fig, 9 ref.

Descriptors: *Activated carbon, *Water treatment, *Chemical treatment, *Drinking water, Potable water, Taste odors, Odor control, Filtration, Adsorbants, Carbon.

The history of the use of activated carbon is discussed, including its early use in the 1920s in the chemistry industry. Since that time, powdered activated carbon has become the most widely used method of taste and odor control. Comparative laboratory testing is the most effective method for evaluating the cost-effectiveness of various carbons, but, in the absence of these data, the iodine number should be used as the basis of selection. Granular activated carbon systems are increasing in number and may be more cost-effective for severe taste and odor problems. The carbon also serves as a filter medium when applied in conventional systems. Therefore, adsorption, filtration and backwash must be considered in design. (Halterman-PTT)
W86-02209

CHEMICAL CONDITIONING FOR WATER SOFTENING AND CORROSION CONTROL,
Brown and Caldwell, Walnut Creek, CA.
D. T. Merrill.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 497-565, 21 fig, 9 tab, 18 ref.

Descriptors: *Water treatment, *Chemical treatment, Drinking water, Potable water, Corrosion, *Corrosion control, Water softening, Water treatment facilities.

The use of Caldwell-Lawrence diagrams to analyze and solve corrosion control problems is described. The diagrams provide a means to assess rapidly and accurately the condition of raw and finished waters, the type and amount of chemicals required to produce the finished water, and the amount of chemical precipitates formed. Insights that are not generally available through the inspection of gross analytical parameters are obtained by the use of these diagrams. Examples of the use of these diagrams in rational analyses of water processing alternatives are provided. (Halterman-PTT)
W86-02210

LIME-SODA SOFTENING PROCESSES,
Greeley and Hansen, Chicago, IL.
C. W. Reh.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 567-596, 10 fig, 7 tab, 21 ref.

Descriptors: *Water treatment, *Chemical treatment, *Water softening, Drinking water, Potable water, Water treatment facilities, Water analysis.

The design of lime softening facilities for municipal plants involves the application of basic water chemistry to continuous, uninterrupted flow regimens to produce a finished water with desirable, consistent and predictable characteristics and properties. Lime-soda ash-caustic softening includes a number of flow patterns, a wide variety of equipment components, and accessory equipment for process control and sludge disposal. Alternate processes and bases for selection, process elements, specialized equipment and bases for selection, process elements, specialized equipment and tankage for the softening operations, and overall softening process control are discussed in detail. (Halterman-PTT)
W86-02211

ION EXCHANGE,
Montana State Univ., Bozeman.
R. L. Sanks.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 597-622, 13 fig, 5 tab, 10 ref.

Descriptors: *Water treatment, *Ion exchange, Chemical treatment, Drinking water, Potable water, Anion exchange, Cation exchange, Resins.

Background information on ion exchange is provided to enable engineers to make preliminary designs, evaluate costs, optimize capital and operating costs, and to guide the manufacturer toward a final design that approaches the optimum. The properties of strong acid, weak acid, strong base, weak base, and intermediate (difunctional) base exchangers are discussed. The design procedure is outlined as follows: select the resin to be used, determine pretreatment requirements, select regenerant level, select the regeneration contact time, recheck the capacity of the resin as a function of the raw water analysis, recheck the capacity vs. the service flow rate, check the leakage of hardness cations, calculate backflow rate, determine pressure drop within the resin beds, and finally, compute the operating cycle by determining the time required for all operations and compute the amount of water treated. Methods of making these determinations and for making estimates on the costs of operating this system, are provided. (Halterman-PTT)
W86-02212

WATER QUALITY IMPROVEMENT BY REVERSE OSMOSIS,
I. Nusbaum, and A. B. Riedinger.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 623-652, 8 fig, 4 tab, 16 ref.

Descriptors: *Water treatment, *Drinking water, *Reverse osmosis, *Ultrafiltration, Potable water, Membrane processes, Filtration, Bacteria, Viruses, Radioactive wastes.

Reverse osmosis and ultrafiltration, two types of pressure-driven membrane systems, are processes that are capable of water quality enhancement above and beyond that of conventional water treatment. The term reverse osmosis usually applies to the separation of ionic or low molecular weight species from a solvent, usually water, by a process involving osmosis. The molecular dimensions of the solute are within one order of magnitude of that of the solvent. Operating pressures for reverse osmosis, as applied to dissolved solids concentrations of up to 10,000 mg/l, are usually in the range of 300 to 600 psi. Ultrafiltration, on the other hand, is a filtration process, utilizing a porous membrane, which is used on bacteria, viruses and colloidal and high molecular weight dissolved organic substances. Several characteristics of reverse osmosis are described to provide engineers with an understanding of the operational requirements and performance of these systems. Included in the discussion are concentration polarization; specific ion and compound rejection; effects of temperature, compaction, pH and total dissolved solids. Applications to removal of organic compounds, bacteria, viruses, pyrogens, radioactive substances and gases are detailed. (Halterman-PTT)
W86-02213

TECHNIQUES AND MATERIALS FOR PREVENTING CORROSION,
American Paint Journal Co., New York.
A. Banov, and H. J. Schmidt.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 653-674, 6 tab, 6 ref.

Descriptors: *Water treatment, *Water treatment, *Coatings, *Linings, Sealants, Epoxy resins, Rubber, Elastomers, Zinc.

Because chemicals involved in water treatment put a severe burden on surface materials, selection of proper coating for surfaces is critical. Guidance for selecting the proper coating for surfaces under mild service conditions are provided. Selection of materials, surface preparation, application and inspection techniques are outlined. A variety of coatings and linings are discussed, including acrylics, epoxies, fluorocarbons, chlorinated rubber, phenol resins, polyesters, silicones, vinyls, urethanes, elastomeric urethanes, metalizing sealers, neoprene, chlorinated polyether, inorganic zinc, chlorosulfonated polyethylene, asphalt, rubber linings, coal tar epoxy, and furane resins. Two highly rated combinations of coatings are (1) a urethane moisture-cure primer, a two-component aromatic urethane intermediate coat, and a two-component aliphatic urethane topcoat, and (2) an inorganic zinc primer, a two-component epoxy/polymide intermediate coat and a high-build urethane topcoat. (Halterman-PTT)
W86-02214

DESIGN OF GRANULAR-MEDIA FILTER UNITS,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. Amirtharajah.

IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 675-737, 14 fig, 10 tab, 48 ref.

Descriptors: *Water treatment, *Water treatment facilities, *Filtration, *Filter media, Drinking water, Potable water, Backwash, Pretreatment of water, Filter rate, Filters.

Granular-media filtration, the final solid-liquid separation process in water treatment, is described. The major filtration principles that effect design of a filtration system include pretreatment, filtration rate, water quality, filter media, run length, backwashing, and the influence of polyelectrolytes. The use of these principles is illustrated with typical process design calculations, including data on design flow, filtration rate, filter media, underdrain system, filter dimensions, filter operational data, backwash system and the conduit system. A plan and section view of the filter block design are provided. (Halterman-PTT)
W86-02215

ESTIMATING WATER SYSTEM COSTS,
Montgomery (James M.), Inc., Pasadena, CA.
R. D. Dickson.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982, p 763-799, 8 fig, 8 tab, 5 ref.

Descriptors: *Drinking water, *Water treatment, *Water treatment facilities, *Costs, Potable water, Cost analysis, Economic aspects, Construction costs, Estimated costs, Maintenance costs, Operating costs.

The need to estimate the costs of the various components of a water treatment system, prior to making a final selection, has resulted in the development of two systems of indices which are normally used within the water works industry. These are referred to as the 'Engineering News-Record' and the 'Handy-Whitman' indices. The history of cost indices, the development of cost curves, the use of cost curves, the operation and maintenance cost-estimating procedures, reservoir costs, pumping station costs, pipeline costs, and water treatment plant costs are discussed. A comparison of cost curves is provided to illustrate different indices and variations in cost projections for different types of facilities. (Halterman-PTT)
W86-02216

O & M MANUALS AND OPERATOR TRAINING,
Regan (T.M.), Inc., Lexington, KY.
T. M. Regan.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 805-814.

Descriptors: *Water treatment, *Water treatment facility, *Training, Drinking water, Potable water, Operation policies, Administration, Maintenance.

Various aspects of operation and maintenance (O to M) manuals, and operator training programs are discussed. The O and M manuals are effective design tools if started during the early stages of the design process, focusing attention on the physical operational problems of the facility. The need for proper operator training is also discussed. Of primary importance is the use of the O and M manual as a training text. If properly prepared and understood by operating personnel, the O and M manual can be the greatest single factor affecting the efficient operation of the facility. (Halterman-PTT)
W86-02217

WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES,
Ann Arbor Science, Ann Arbor, MI. 1982. Edited by Eric J. Schiller and Ronald L. Droste. 368 p.

Descriptors: *Water supply development, Developing countries, *Sanitation, *Water treatment, *Wastewater treatment, Water supply, Public health, Water resources development, Water management, Training, Economic aspects, Social aspects, Waste disposal, Project planning.

This book is a revised and improved version of the material from a course given at the University of Ottawa during June 1981. Planning for this course evolved from an International Development Research Center (IDRC)/Canadian International Development Agency (CIDA) man-power training project and workshops that were conducted in East and Southern Africa during 1978-1980. As a result of extensive cooperation with overseas personnel, the dual emphases of renewable energy technologies and social, management and economic aspects emerged. These two foci provide the main outline for this book. This book gives a comprehensive coverage of the technical and management aspects of implementing water supply and sanitation systems in developing countries. It should prove valuable for both technical and non-technical personnel who want to orient themselves to these activities. The text is divided into four sections. Section 1 deals with water supply technologies. Section 2 considers low-cost sanitation options. Section 3 deals with management aspects, and Section 4 discusses interfacing programs with developing countries. (Geiger-PTT)
W86-02324

WATER SUPPLY AROUND THE WORLD--APPROPRIATE TECHNOLOGY,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. A. Okun.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 9-21, 11 fig.

Descriptors: *Water supply development, *Developing countries, *Sanitation, *Water treatment, *Wastewater treatment, Water supply, Water resources development, Water management, Economic aspects, Waste disposal, Project planning, Automation, Capital costs, Labor.

While it is not likely that a community will opt for improved sanitation ahead of water supply, the commitment should be made to both at the same time. In developing countries, water supply and sanitation facilities are often not yet available to people in rural areas, villages and many urban areas. The principles on which water supply and sanitation facility design and operation are based are the same in developed and developing countries. The only difference is that in developing countries, the facilities may be more labor-intensive than capital intensive. Since water supply and wastewater collection and treatment facilities are often among the most expensive and prominant of all investments made by communities in developing countries, the most modern technologies are usually opted for, over less costly and usually more adequate conventional technologies. Not only does the use of excessive technology detract funds from higher-priority needs, but investment in this technology becomes a heavy liability. Examples of the use of inappropriate technology for water treatment in Africa and Asia are given. (Geiger-PTT)
W86-02325

REGIONALIZATION OF WATER SUPPLY AND SANITATION SERVICES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. A. Okun.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 23-35, 1 fig, 6 ref.

Descriptors: *Regional development, *Water supply development, *Developing countries, *Sanitation, *Water management, Water supply, Water resources development, Training, Economic aspects, Social aspects, Political aspects, Wastewater facilities, Wastewater treatment, Waste disposal, Project planning, Wastewater disposal.

In 1945, the British initiated a program of regionalization of water supplies to optimize investments in water supply, wastewater collection and disposal, river regulation, and the amenity uses of inland waters. The uniqueness of water projects in relation to climate, precipitation, topography, density and distribution of population, industrial development, land use, economic status, availability of human resources, and social structure and customs must be recognized. The need for pure water supplies is important in developing countries where infectious diseases are more likely to spread. Integration of wastewater collection and disposal with water supply is particularly appropriate in arid and semiarid areas of the world where reclaimed wastewaters are used for nonpotable purposes. Integration of these services can afford efficiencies and economies of scale similar to those obtained by regionalization. When adopting a regionalization approach in developing countries, certain guidelines should be followed. The region should encompass people of the same cultural background. The region should be close to regional headquarters, or be large enough to have its own headquarters. The region should conform to political boundaries and should have potential for education and training centers, and be able to manage its own facilities. (Geiger-PTT)
W86-02326

HAND-PUMP TECHNOLOGY FOR THE DEVELOPMENT OF GROUNDWATER RESOURCES,
Agency for International Development, Washington, DC.
For primary bibliographic entry see Field 8C.
W86-02327

RENEWABLE ENERGY PUMPING FROM RIVERS AND STREAMS,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W86-02328

WIND-POWER PUMPING,
Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 8C.
W86-02329

ROOFTOP RAINWATER CATCHMENT SYSTEMS FOR DRINKING WATER SUPPLY,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 3B.
W86-02330

SIMPLE WATER TREATMENT METHODS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
R. L. Droste, and F. E. McJunkin.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor, MI, 1982. p 101-122, 10 fig, 2 tab, 38 ref.

Descriptors: *Water treatment, *Water quality, *Chlorination, *Developing countries, *Filtration, Sand filters, Water supply, Water supply development, Aeration, Flocculation, Coagulation, Disinfection, Heavy metals, Enteric bacteria, Coliforms, Public health.

In less developed countries, the general rule for water treatment is to provide the minimum treatment necessary. A good water source is the first protective barrier against waterborne disease. Microbiological quality is the major measure of the quality of water. Fecal coliform and streptococcus serve as indicator organisms of microbiological purity. In developing countries, nitrates can cause methemoglobinemia in infants under 3 months of age. Fluorides in moderate amounts are desirable to prevent dental caries. Other dissolved inorganic salts affect the taste of water and can cause a temporary laxative effect. Fe and Mn cause staining of fixtures and clothes and contribute taste and odors. In developing countries, operation and maintenance of water treatment plants is the responsibility of national or regional governments. Storage of water supplies offers additional protection against emergency water demands. Aeration, filtration and chlorination are common practices for the treatment of water. Sand filtration may be

incorporated into source protection by using an infiltration gallery. There are a number of simple chlorination devices that can be used if the supply of solid chlorine is assured. (Geiger-PTT)
W86-02331

COST-EFFECTIVE WATER SUPPLY AND SANITATION PROJECTS FOR DEVELOPING COUNTRIES,
International Bank for Reconstruction and Development, Washington, DC. Dept. of Transportation and Water.
For primary bibliographic entry see Field 6C.
W86-02337

FINANCING WATER SUPPLY SYSTEMS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 6C.
W86-02338

PROCESS OF PROJECT PREPARATION,
Walker and Partners Ltd., Ottawa (Ontari).
For primary bibliographic entry see Field 6B.
W86-02339

OPERATION AND MAINTENANCE OF WATER SUPPLY AND SANITATION SYSTEMS,
Walker and Partners Ltd., Ottawa (Ontari).
For primary bibliographic entry see Field 5D.
W86-02341

TRAINING OF COUNTERPARTS,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 9A.
W86-02342

5G. Water Quality Control

ACID MINE DRAINAGE: CONTROL AND ABATEMENT RESEARCH,
Bureau of Mines, Pittsburgh, PA. Pittsburgh Research Center.
For primary bibliographic entry see Field 5D.
W86-01978

ASSESSMENT AND CONTROL OF WATER CONTAMINATION ASSOCIATED WITH SHALE OIL EXTRACTION AND PROCESSING,
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5B.
W86-01979

MECHANISMS FOR GROUNDWATER CONTAMINATION BY UCG: PRELIMINARY CONCLUSIONS FROM THE HOE CREEK STUDY,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5B.
W86-01981

PHYSICAL PROPERTIES AND LEACH TESTING OF SOLIDIFIED/STABILIZED INDUSTRIAL WASTES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5E.
W86-02001

SITING HAZARDOUS WASTE MANAGEMENT FACILITIES: THEORY VERSUS REALITY,
Boston Univ., MA. Dept. of Urban Affairs and Planning.
R. F. Anderson, and M. R. Greenberg.
IN: Hazardous and Toxic Wastes: Technology, Management and Health Effects, The Pennsylvania Academy of Science, Easton, PA. 1984. p 170-186, 2 fig, 6 tab, 29 ref.

Descriptors: *Water quality control, *Waste disposal, *Landfills, New Jersey.

A site screening method is useful in making decisions for locating new hazardous waste sites. Applied to 46 known disposal sites in Lower Raritan/Middlesex County 208 Water Management Area, central New Jersey, the method shows that most of these sites are not acceptable according to criteria in the proposed method. The 272 cells of 2 x 2 kilometers each were evauated according to 22 criteria, grouped into 9 composite statistical factors. Each cell rated 1-4 (most suitable to least suitable) in each of the 9 categories. A composite rating (1-5) was developed, 1 having the largest number of most suitable ratings and 5 having more than one least suitable ranking. Of the 38 most suitable cells, only 4 contain existing landfills. The other 42 landfills in this region, including the Kin-Buc landfill in Edison, are situated in land unsuitable for this purpose. (Cassar-PTT)
W86-02045

ENVIRONMENTAL IMPACT OF POLLUTION CONTROLS ON THE THAMES ESTUARY, UNITED KINGDOM,
Thames Water Authority, Reading (England).
P. Casapieri.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 489-504, 4 fig, 4 tab, 11 ref.

Descriptors: *Water quality control, *Estuaries, *Management, *Thames River, *United Kingdom, Water pollution control, Water pollution sources, Dissolved oxygen, Oxygen, Legislation, Wastewater treatment, Aquatic habitats, Habitats, Fish, Salmon, Standards, Water quality standards, Rivers, Tidal rivers.

The Thames River Estuary, badly polluted with industrial and human waste since the 18 century, has been recovering in recent years. Dissolved oxygen levels started to improve about 1870, following pollution control legislation in 1857. However, starting about 1900, dissolved oxygen again decreased, reaching zero for the period 1940-1965. In 1973 the 1600 separate water authorities responsible for pollution control in England and Wales were reorganized into 10 regional water authorities. Environmental quality objectives were developed by the Pippard Committee. Beginning with dissolved oxygen goals (minimum of 1 mg/liter), the next step was a management strategy to establish dissolved oxyten levels suitable for a migratory fish habitat. Six classes of rivers were defined, each with water quality objectives and standards. Likewise, tidal waters were classified into five categories. One measure of water quality is the number of fish species recorded in the Key-Gravesend reach. This has increased from <5 in 1964 to 50 in the late 1960's to nearly 100 in 1980. A 17-year salmon introduction project started in 1979 has yielded salmon caught by rod and reel and by electrofishing. (Cassar-PTT)
W86-02093

TREATMENT ALTERNATIVES FOR GROUNDWATER CONTAMINATION,
Montgomery (James M.), Inc., Reston, VA.
For primary bibliographic entry see Field 5F.
W86-02110

INVESTIGATION INTO THE WATER QUALITY BENEFITS OF CHLORINATING PAPER-MILL EFFLUENTS,
Pennsylvania Dept. of Environmental Resources, Harrisburg.
For primary bibliographic entry see Field 5D.
W86-02112

CONSTRUCTION TECHNIQUES FOR REMEDIAL DESIGN AT A CONNECTICUT SUPERFUND SITE: A CASE STUDY,
Hart (Fred C.) Associates, Inc., New York.
B. D. Gillen, and D. E. Webster.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 497-509, 6 fig, 1 tab, 3 ref.

Descriptors: *Water pollution control, *Trenches, *Design criteria, *Landfills, *Drains, *Sewers, Ditches, Leachates, Dewatering, Leaching, Cost analysis, Waste disposal, Land disposal, Waste dumps, Sanitary landfills, Case studies.

The methods of construction and some design considerations used during the installation of a leachate collection trench drain at a landfill in Connecticut is described. The problems related to non-uniform soil conditions were remedied by using finer till from other stockpiles onsite. Compaction was improved creating a temporary till dam across the trench to retain liquids long enough to allow till to be placed on the trench bottom. Permeability tests were lengthy and pre-testing of sites is recommended. Dynamite blasting at the site caused fissures through which leachate could travel. An epoxy sealant was applied to prevent leachate escape through fissures. The manholes at the bottom of downgradient barriers had to be surrounded with an impermeable barrier to prevent leakage from the system. The entire system, including a trunk line to connect the collection drain to the existing sanitary sewer, was installed for about $400,000. The sytem currently collects approximately 20,000 gpd, an amount which may decrease over time as the groundwater level drops. (Geiger-PTT)
W86-02118

HAZARDOUS WASTE MANAGEMENT FOR THE 80'S.
For primary bibliographic entry see Field 5E.
W86-02219

USE OF AERIAL PHOTOGRAPHY AND REMOTE SENSING IN THE MANAGEMENT OF HAZARDOUS WASTES,
Ohio State Univ., Columbus.
J. G. Lyon.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 163-171, 18 ref.

Descriptors: *Aerial photography, *Remote sensing, *Infrared imagery, *Landfills, *Waste disposal, Groundwater, Industrial wastes, Solid wastes, Liquid wastes, Site selection, Environment.

Aerial photographs and remote sensor data are useful in providing both current and historical information on sites of hazardous wastes, and it is demonstrated that these tools can save money and human resources and can reduce toxic waste exposure. Historical photographic data can determine presence or absence of landfills, subsequent land use on closed landfills, and historical vegetation, soil and hydrological conditions. Current data can assist in the monitoring of soil and water conditions, in defining the chaacteristics of vegetation cover, and in helping to prioritize abatement activities. Both siting and closure of hazardous waste sites can be facilitated by use of these techniques. Color infrared photography is valuable for monitoring water characteristics, since very thin layers of water can be distinguished. This is useful in locating leachate movement, ponding of water, erosion and condition of diversions. Aerial photographs have been acquired in the United States on a consistent basis since 1936. Information on sources for obtaining these photographs is given. (Halterman-PTT)
W86-02224

REMEDIAL ACTION ALTERNATIVES FOR ABANDONED HAZARDOUS WASTE SITES,
P. B. Lederman.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 265-276, 4 fig, 3 tab.

Descriptors: *Wastes, *Waste disposal, *Environment, *Cleanup, On-site investigations, Solid wastes, Liquid wastes, Landfills, Industrial wastes.

Various alternatives available for remedial action (cleanup) of abandoned hazardous waste sites (which will generally be pits, barrel repositories or burial grounds) are considered. After a field inves-

tigation has revealed the extent and type of contamination and sources of material (inventory), a judgment is made on the appropriate action. The alternatives to be considered include no action, site management, stabilization and closure, encapsulation, fixation, on site treatment, off-site secure landfill, or off-site treatment. The use of field tests, pilot studies, financial considerations, and assessment of risk of failure, to determine the most appropriate courses of action are discussed. (Halterman-PTT)
W86-02225

SLURRY TRENCH CUTOFF WALLS FOR HAZARDOUS WASTE ISOLATION,
D. J. D'Appolonia.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 289-305, 12 fig, 2 tab, 2 ref.

Descriptors: *Trenches, *Waste management, *Design criteria, *Waste disposal, *Cutoffs, Solid wastes, Liquid wastes, Environment, Landfills, Leachates.

Soil-bentonite slurry trench cutoff walls are an effective tool for isolating chemical and industrial waste materials that are disposed of in landfills or ponds. They can provide a vertical barrier around a disposal site without uncovering or disturbing the waste. The geological conditions where slurry trench construction is most applicable are reviewed, as are the important elements of slurry trench design. Critical design considerations include the connection details between the cutoff and the underlying aquaclude and the blend of soils and bentonite used for the landfill. In order to obtain a low permeability , containment-resistant backfill, a high percentage of fine plastic material must be used. A clayey sand or sandy clay containing 30 to 60 percent fines blended with bentonite slurry is usually satisfactory for most waste isolation applications. (Halterman-PTT)
W86-02226

CLAY LINER PERMEABILITY - A PROBABILISTIC DESCRIPTION,
Carnegie-Mellon Univ., Pittsburgh, PA.
For primary bibliographic entry see Field 5E.
W86-02227

CONTAINMENT AND ENCAPSULATION OF HAZARDOUS WASTE DISPOSAL SITES,
For primary bibliographic entry see Field 5E.
W86-02228

ESTIMATES OF SEEPAGE THROUGH CLAY COVERS ON HAZARDOUS WASTE LANDFILLS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W86-02229

MONITORING, RECOVERY AND TREATMENT OF POLLUTED GROUNDWATER,
J. R. Quince, and G. L. Gardner.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 357-388, 13 fig, 2 tab.

Descriptors: *Groundwater pollution, *Industrial wastes, *Water treatment, Environment, Groundwater recharge, Water quality, Biological treatment, Chemical treatment.

An overview of techniques currently applied to recover and treat polluted groundwater is presented. The process consists of several steps: A preliminary investigation of existing site conditions, selection of a method of recovery (usually gravity collection, suction lift or positive displacement), selection of a treatment system based on the contaminant(s) being recovered, use of treatment system effluent for aquifer recharge, and monitoring. Four case histories encompassing a variety of contaminants are presented to illustrate the process. Treatment steps can be divided into three primary classifications: physical, chemical and biological. Physical techniques employ phase or component separation. Chemical treatment techniques employ the addition of a reactive material to provide for a change in chemistry of the waste stream. Biological treatment uses enhanced mirobiological activity to convert contaminants to non-toxic by-products. In situ recovery and treatment techniques including biodegradation have proven more effective than excavation and disposal of contaminated material. (Halterman-PTT)
W86-02230

SALINITY IN WATERCOURSES AND RESERVOIRS,
For primary bibliographic entry see Field 5B.
W86-02264

EVOLUTION OF A COST SHARING POLICY FOR FEDERAL CHLORIDE PROJECTS,
Army Engineer Div. Southwestern, Dallas, TX.
For primary bibliographic entry see Field 6C.
W86-02266

PROBLEM OF SALINITY AND ITS CONTROL, RIVER MURRAY, AUSTRALIA,
River Murray Commission, Canberra (Australia).
For primary bibliographic entry see Field 5B.
W86-02267

DRAINAGE AND SALINITY CONTROL PROGRAMS IN PAKISTAN,
International Bank for Reconstruction and Development, Washington, DC.
W. D. Fairchild.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 43-52.

Descriptors: *Saline water; *Salinity, Irrigation, Water requirements, Water supply, Water use, Water users, Economic aspects, Pakistan, Indus Basin, Groundwater.

Several salinity-related water sector programs in Pakistan are outlined and the similarities with the Colorado Basin situation are discussed. Pakistan has up to 1.6 megahectares underlaid with saline groundwater that fits their 'disaster' classification of having a continuous high water table of less than 1.5 meters. Recommendations concerning salinity control included: exploitation of fresh groundwater resources by the private sector; implantation of a program to transfer operation and maintenance of existing public tubewells in fresh groundwater zones to the private sector; and placing high priority on control of waterlogging in saline groundwater zones in future investment programs. (Halterman-PTT)
W86-02268

LEGAL AND INSTITUTIONAL CONSTRAINTS TO SALINITY CONTROL,
Bureau of Reclamation, Provo, UT. Utah Projects Office
For primary bibliographic entry see Field 6E.
W86-02269

USDA PLANNING PROCESS FOR COLORADO RIVER BASIN SALINITY CONTROL,
Soil Conservation Service, Portland, OR. West National Technical Center.
H. D. Hedlund.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 63-77, 2 fig, 2 tab, 20 ref.

Descriptors: *Salinity, *Saline water, *Irrigation, *Irrigation procedures, Water requirements, Irrigation requirements, Water supply, Water use, Water users, Colorado River, Colorado River Basin.

Several aspects of the USDA program for salinity control in the Colorado River Basin are reviewed. The planning process consists of the following six major steps: define the problem (quantification of the salinity problem); inventory and analysis (inventory of on-farm practices and analytical procedures to evaluate conditions); formulate alternative plans (determination of possible treatment opportunities); prepare displays of effects and compare alternative plans (displays aid in identification of tradeoffs between alternatives); and select the recommended plan (includes consideration of acceptability by local farmers and ranchers and the obligation to meet national and international water conservation and interstate water quality goals). Several on-going programs, including the Wellton-Mohawk, Grand Valley and Vinta Basin, are discussed. (Halterman-PTT)
W86-02270

SALINITY BUBBLES AND OFFSETS: A CONCEPT PAPER,
Environmental Protection Agency, Denver, CO. Water Management Div.
G. R. Reetz.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 79-91, 30 ref.

Descriptors: *Salinity, *Saline water, Irrigation, Irrigation procedures, Water requirements, Irrigation requirements, Water supply, Water use, Water users, Colorado River, Colorado River Basin, Legal aspects, Legislation.

The impacts of salinity and the principles of a bubble/offset policy for environmental protection are discussed and the specifics of the problem of salinity in the Colorado River are described. Impacts on land and water uses include reduced crop yield, additional municipal water treatment costs, and increased corrosion and wear at water treatment facilities. The bubble concept applies to the practice of a facility rearranging emission control requirements, decreasing controls where control costs are high in exchange for increased controls where costs are low. The offset policy permits a new facility to enter a non-attainment area, provided the firm offsets its emissions with emission reductions obtained from existing firms in the non-attainment area. As related to Colorado River salinity control, the state of California recommended a bubble (the salinity concentrations at a particular time) bounded by the outflow from the Upper Basin, and recommended a basinwide offset policy for maintaining the bubble. The flexibility of the bubble and offset concepts, and their appropriateness for controlling salinity in the Colorado River Basin are discussed.
W86-02271

PLANNING AND IMPLEMENTATION FRAMEWORK FOR SALINITY CONTROL IN THE INDUS RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
M. S. Shafique, and G. V. Skogerboe.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 93-102, 3 fig, 1 tab, 5 ref.

Descriptors: *Saline water, *Salinity, Irrigation, Water requirements, Water supply, Water use, Water users, Economic aspects, Pakistan, Indus River, Groundwater.

The planning phase of salinity control in the Indus River Basin, Pakistan, included several steps. First, evaluation of alternatives for each individually irrigated area leads to practices that can effectively control salinity resulting from the use of water for irrigation. The second step is to define the best management practices by optimizing the cost-effectiveness relationships from individual areas into a single strategy. The third step assigns the required level of salinity control that should be implemented in each subbasin or irrigated area. The role of farmer organizations, monitoring, and evaluation in assuring the effectiveness of ongoing programs are discussed. (Halterman-PTT)
W86-02272

SOUTHWESTERN SALINITY SITUATION: THE ROCKIES TO THE MISSISSIPPI,
Army Engineer Div. Southwestern, Dallas, TX.
For primary bibliographic entry see Field 5B.
W86-02274

NATURAL SALT POLLUTION CONTROL BRAZOS RIVER BASIN, TEXAS,
Army Engineer District, Fort Worth, TX.
For primary bibliographic entry see Field 5B.
W86-02276

IMPROVING WATER MANAGEMENT PRACTICES ON SURFACE IRRIGATED LANDS: THE ROLE OF MODELING,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
W. R. Walker.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston, 1984. p 203-211, 4 fig, 1 tab, 13 ref.

Descriptors: *Salinity, *Saline water, *Irrigation, *Water quality control, Model studies, Irrigation design, Irrigation efficiency, Irrigation practices, Irrigation return flow.

Some of the faulty modeling assumptions made about uniform application of irrigation water, and the resultant bias of the results which favor off-farm salinity control options, are discussed. The need for more realistic irrigation models is stressed, and state-of-the-art models are described. Hydrodynamic, zero-inertia, kinetic-wave and volume balance models are outlined. Several ways in which surface irrigation models can be helpful are discussed. For instance, after an on-farm salinity control measure has been implemented at a structural level, the model can be used in conjunction with other management tools to improve and maintain effective irrigation practices. The use of surface irrigation models to predict the use of surge flow, cablegation, cutback, or tailwater reuse systems is also discussed. (Halterman-PTT)
W86-02282

LONGITUDINAL-VERTICAL HYDRODYNAMICS AND TRANSPORT WITH CHEMICAL EQUILIBRIA FOR LAKE POWELL AND LAKE MEAD,
Edinger (J.E.) Associates, Inc., Wayne, PA.
For primary bibliographic entry see Field 5B.
W86-02283

SKIMMING WELL MODEL FOR SALINITY CONTROL,
California Univ., Davis. Dept. of Civil Engineering.
B. A. Chandio, and B. E. Larock.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 235-242, 3 fig, 7 ref.

Descriptors: *Salinity, *Saline water, *Groundwater, *Water quality control, Model studies, Irrigation practices, Well hydraulics, Well water, Shallow water, Skimming.

A three-dimensional miscible fluid model of transient unconfined flow toward a skimming well is described and the role of such a model in salinity control is discussed. The ability to predict or control the distribution of salinity with skimming wells depends on knowledge of the hydromechanics of flow near the well. Important geometric factors that effect the hydromechanics, and thus the well operation, are described. Various well-operation strategies, such as depth and duration of pumping, can be tested for a suitable set of geometric parameters. In this way, the optimum means of skimming water from the relatively thin band of fresh groundwater which overlies a thicker saline water layer in an unconfined aquifer, can be determined. However, owing to the use of linear elements in the model, computations employing a larger, finer mesh of elements is suggested. (Halterman-PTT)
W86-02285

SALINITY CONTROL THROUGH WATER CONSERVATION IN THE UPPER COLORADO RIVER BASIN,
Utah State Univ., Logan. Coll. of Engineering.
For primary bibliographic entry see Field 3F.
W86-02286

IRRIGATION WITH SALINE GROUNDWATER AS A STRATEGY FOR SALINITY CONTROL IN THE SHEPPARTON REGION OF NORTHERN VICTORIA,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
For primary bibliographic entry see Field 3C.
W86-02287

CASE STUDY OF A SALINITY CONTROL PROGRAM, VINTA BASIN, UTAH,
Soil Conservation Service, Salt Lake City, UT.
H. T. Brown.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 275-284, 1 fig, 1 tab, 6 ref.

Descriptors: *Salinity, *Saline water, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture, Vinta Basin, Utah.

Poor irrigation practices and natural salt sources resulted in increased total dissolved solids entering streams near irrigated lands. Technical assistance from the Soil Conservation Service and the Agricultural Stabilization and Conservation Service was initiated, at a cost of about $0.5 million per year, to control the salinity problem. Pasture management, irrigation water management, wildlife habitat management, land leveling and reservoir regulation are included in the salinity control program. It is estimated that 69,475 metric tons of salt-loading from the irrigated area can be eliminated from the Colorado River system annually. On-site benefits, including lower operating costs and higher crop yields, are also discussed. (Halterman-PTT)
W86-02289

CASE STUDY OF A MAJOR AGRICULTURAL CONTROL PROGRAM - THE GRAND VALLEY EXPERIENCE,
Soil Conservation Service, Denver, CO.
For primary bibliographic entry see Field 3F.
W86-02290

GRAND VALLEY STATE ONE MONITORING PLAN AND IMPLEMENTATION,
Bureau of Reclamation, Grand Junction, CO.
D. L. King.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 295-304, 3 fig, 2 tab, 3 ref.

Descriptors: *Salinity, *Saline water, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture, Colorado River.

In order to improve groundwater flows and reduce salt loading, a 6.8 mile length of the Government Highline Canal was lined with concrete, and cross-drainage facilities were installed. To assess the effectiveness of these improvements, a hydrologically-closed basin, known as the Reed Wash study area, has been equipped to monitor surface and groundwater inflows, outflows, and levels. A monitoring program, implemented to establish preconstruction hydrologic conditions and to observe the effects of canal lining and lateral piping on salt loading in the watershed, is discussed. The monitoring program indicates that the water system improvements have been effective in reducing seepage and salt loading from canals and laterals. This area will be monitored for a number of years to verify the effectiveness of the lining program. (Halterman-PTT)
W86-02291

MEASURES FOR REDUCING RETURN FLOWS FROM THE WELLTON-MOHAWK IRRIGATION AND DRAINAGE DISTRICT,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
R. J. Effertz, W. K. Sidebottom, and M. D. Turley.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 305-314, 1 tab.

Descriptors: *Salinity, *Saline water, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture, Colorado River.

A variety of measures to reduce salt loading of the Colorado River are discussed. Acreage reduction, on-farm measures and technical assistance are stressed. Research projects that added to irrigation efficiencies and reduction in drainage water included monitoring soil salinity; preventing clogging of emitters in trickle irrigation systems; managing dead-level irrigation; automating surface irrigation, and evaluating economic aspects of alternative irrigation systems. Reduced irrigation acreage and on-farm improvements resulted in significant reductions in the drainage of saline waters into the Colorado River. (Halterman-PTT)
W86-02292

SALINITY CONTROL AND DRAINAGE IN NORTHERN VICTORIA (AUSTRALIA),
Victoria State Rivers and Water Supply Commission, Armadale (Australia).
For primary bibliographic entry see Field 3F.
W86-02293

CONTROLLING SALINITY IN THE COLORADO RIVER BASIN, THE ARID WEST,
Bureau of Reclamation, Denver, CO. Colorado River Water Quality Office.
A. R. Jonez.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 337-347, 3 fig, 5 ref.

Descriptors: *Saline water, *Salinity, *Water quality control, Irrigation, Water use, Irrigation effects, Irrigation practices, Environmental effects, Agriculture, Colorado River, Desalination.

The sources of salt in the Colorado River are discussed. The primary sources are natural (47%), irrigation (37%) and reservoir evaporation (12%). Several activities designed to reduce salt loading and salinity levels in the Colorado River are discussed. They include irrigation source control (land leveling and canal sealing), point source control (removal of salt from localized areas such as mineral springs, abandoned oil wells, and geysers), diffuse source control (watershed management, land treatment and the collection and disposal of irrigation return flows). Major issues and concerns pertaining to salinity control are discussed, and the need for further development in salinity control technology is stressed. (Halterman-PTT)
W86-02295

SALINITY CONTROL BY PUMPING AND DEEP WELL INJECTION - THE PARADOX VALLEY UNIT,
Bureau of Reclamation, Durango, CO.
E. G. Jensen, and R. W. Leach.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 349-358, 6 fig.

Descriptors: *Saline water, *Salinity, *Water quality control, Groundwater, Water supply, Colorado River, Colorado, Dolores River, Environmental effects, Well hydraulics, Economic aspects, Hydraulics.

A plan to reduce salinity inputs to the Dolores River, a tributary of the Colorado River, is discussed. The Dolores River picks up an estimated 205,000 tons of salt annually as it passes over a salt anticline in Paradox Valley, Colorado. A control plan which has been adopted involves pumping brine from wells paralleling the Dolores River and adjacent to brine inflow areas. The pumping will lower the freshwater-brine interface below the river channel, thus preventing the brine from entering the river. Brine disposal methods have not been selected; however, disposal in large evaporation ponds, or by deep-well injection, appear to be the most attractive alternatives. (Halterman-PTT)

W86-02296

MEEKER DOME SALINITY INVESTIGATION,
CH2M Hill Central, Inc., Denver, CO.
For primary bibliographic entry see Field 5B.
W86-02297

SALINITY CONTROL BENEFITS THROUGH REGULATION OF PRODUCED WATER,
Utah Bureau of Water Pollution Control, Salt Lake City.
J. R. Riding.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 367-375, 1 tab, 26 ref.

Descriptors: *Saline water, *Salinity, *Water quality control, Groundwater, Water supply, Environmental effects, Well hydraulics, Deep wells, Ponds, Water pollution, Groundwater pollution.

Methodologies are discussed by which 'produced' water (from oil and gas production) is disposed, and salinity loading is minimized. The use of evaporation ponds and injection wells have long been standard practices; however, the need has existed for more stringent regulations regarding these two methods. Regulations recently developed for pond disposal insure that with proper siting, design, construction, and monitoring, minimal ground water contamination will take place. Successful disposal by injection well can be attained if water is injected into formations that are below freshwater zones, and separated from them by impermeable layers to prevent the upward migration of the injected fluids. (Halterman-PTT)
W86-02298

ARKANSAS-RED RIVER BASINS CHLORIDE CONTROL PROJECT: TECHNICAL FEASIBILITY STUDIES FOR PLAN OF CONTROL,
Corps of Engineers, Tulsa, OK.
J. H. Roberts.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 377-387, 8 fig, 1 tab, 2 ref.

Descriptors: *Saline water, *Salinity, *Water quality control, Groundwater, Water supply, Environmental effects, Well hydraulics, Deep wells, Ponds, Water pollution, Groundwater pollution.

A summary of the chloride contamination problem in the Arkansas and Red River Basins is provided, and an overview of technical feasibility studies necessary to develop a control plan is presented. The source of the salt is thick deposits of halite under a large area of the southwestern United States. Salt loading into the Arkansas and Red River Basins has degraded the waters to such a degree that they are unusable for most purposes. Surface water investigations indicate that three separate salt emission areas exist in a study area along Jonah Creek, a tributary of the Red River. Groundwater pump tests have shown that they are also separate hydrologically. Brine collection and disposal methodologies are discussed. The most efficient techniques involve pumping brine to the surface and then disposing of it by means of deep well injection. (Halterman-PTT)
W86-02299

GLENWOOD-DOTSERO SPRINGS SALINITY CONTROL PROJECT,
URS Co., Denver, CO.
C. A. Macko.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 389-396, 1 fig, 1 tab.

Descriptors: *Saline water, *Salinity, *Water quality control, Groundwater, Water supply, Environmental effects, Well hydraulics, Economic aspects, Colorado River, Drainage wells.

Various aspects of a proposed salinity control project, including planning, field investigations, results, and the conclusions, are discussed. The results of the field investigation were used in the design and cost estimates for the components of the recommended plan. Data indicate that a well field could collect approximately 0.20 cu m saline water/sec from the subsurface without dilution from the Colorado River. A computer model was calibrated with aquifer test data and extensive modeling efforts were undertaken to design a well that would not impact upon several nearby commercial springs. Annual reductions in salinity and water depletion rates that would result from the implementation of the recommended plan are discussed. (Halterman-PTT)
W86-02300

SALINITY CONTROL ON THE SMOKY HILL RIVER IN CENTRAL KANSAS,
Kansas State Geological Survey, Lawrence.
C. D. McElwee, A. Fleming, M. Butt, and A. Severini.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 397-406, 7 fig, 2 tab, 5 ref.

Descriptors: *Saline water, *Salinity, *Water quality control, Model studies, Groundwater, Water supply, Well hydraulics, Drainage wells, Relief wells, Smoky Hill River, Kansas.

The possible use of relief wells to alleviate the problem of high salinity in the Smoky Hill River is discussed. Modeling methods are applied to evaluate the effectiveness of various systems. Results indicate that the volume of salt water leakage could be reduced by 20%. In some cases, regional flow can capture about 50% of the freshwater leakage induced by the relief wells, resulting in considerable dilution of the discharged water. The most efficient net effect of the relief-well systems modeled was a reduction of 77-85% in the salt load discharged to the alluvium. The model predicts, however, that most of the dilution effect will not be felt at the discharge area for 40-160 years. (Halterman-PTT)
W86-02301

PRICE/SAN RAFAEL RIVER BASINS SALINITY INVESTIGATION,
CH2M/Hill, Boise, ID.
For primary bibliographic entry see Field 5B.
W86-02302

LIVING WITH SALINITY: AN EVALUATION OF TWO POLICY MEASURES WITHIN A REGIONAL FRAMEWORK.
Hebrew Univ. of Jerusalem (Israel). Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3C.
W86-02304

IRRIGATION AS A SOLUTION TO SALINITY PROBLEMS OF RIVER SYSTEMS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 3C.
W86-02305

AQUATRAIN PIPELINE SYSTEM,
Bureau of Reclamation, Denver, CO. Office of Saline Water Transport and Use.
For primary bibliographic entry see Field 3C.
W86-02307

SALT GRADIENT SOLAR PONDS.
Department of Energy, Washington, DC.
For primary bibliographic entry see Field 3C.
W86-02308

FISH AND WILDLIFE MITIGATION PROGRAM FOR THE COLORADO RIVER BASIN SALINITY CONTROL PROJECT - A CASE HISTORY,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
T. A. Burke, D. E. Busch, and W. E. Rinne.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 539-548, 1 tab, 2 ref.

Descriptors: *Saline water, *Salinity, Mitigation, Wildlife conservation, Fish conservation, Arizona, California.

Salinity control measures impact upon fish and wildlife in a variety of ways, including: loss of surface water and associated wetlands in and along the lined canals due to elimination of seepage; loss of vegetation for project rights-of-way; and loss of irrigated croplands in the Wellton-Mohawk area (retired from agricultural use). The development of mitigation strategies designed to offset these, and other losses, are outlined. General mitigation measures include: use of existing main outlet drains as a conveyance channel for salt water wastes; screening the feed water intake to the desalting plant to reduce fish loss; conducting fish salvage during canal dewatering works, and providing bridges, siphons, and escape ladders in and along the canals for both human and wildlife use. Specific mitigation projects for both Arizona and California are detailed. (Halterman-PTT)
W86-02312

TRIANGLE CONSERVATION DISTRICT - A CASE STUDY IN DRYLAND SALINE SEEP CONTROL,
Triangle Conservation District, Conrad, MT.
T. Dodge, J. Holzer, W. Adams, and J. Farkell.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 561-570, 2 fig, 1 tab, 6 ref.

Descriptors: *Salinity, *Saline water, *Seep water, Seepage control, Seeps, Percolation, Environmental effects, Wells, Montana.

Saline seeps, defined as recently developed saline soils in non-irrigated areas, that are wet some or all of the time, are discussed. Control of seeps is obtained by a variety of techniques, including selective crop growth, and pumping ground water out of localized seeps, thus lowering the water table. Farm-by-farm assistance for saline seep control is the quickest and best way to solve the problem. Developing a successful saline plan requires a combination of the 'ideal' solution and practical considerations--economics, land ownership, farm program participation, type of farm operation, etc. Effective saline seep control frequently alters the entire farm operation. The changes in management require technical assistance throughout the implementation stage by a team of agronomic and soil specialists. (Halterman-PTT)
W86-02314

SALINITY CONTROL PROBLEMS: NON-AGRICULTURAL,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 5B.
W86-02316

CRITIQUE - SALINITY CONTROL PROBLEMS: AGRICULTURAL,
Science and Education Administration, Fort Collins, CO. Agricultural Research.
For primary bibliographic entry see Field 5B.
W86-02317

REUSING SALINE DRAINAGE WATERS FOR IRRIGATION: A STRATEGY TO REDUCE SALT LOADING OF RIVERS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 3C.
W86-02318

DESALTING BY REVERSE OSMOSIS AT YUMA DESALTING PLANT,
Bureau of Reclamation, Yuma, AZ. Yuma Projects Office.
For primary bibliographic entry see Field 3A.
W86-02319

GEOLOGIC AND HYDROLOGIC DATA COLLECTED DURING 1976-1984 AT THE SHEFFIELD LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE AND ADJACENT AREAS, SHEFFIELE, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02372

LITERATURE REVIEW OF SURFACE-WATER QUALITY IN THE CUYAHOGA VALLEY NATIONAL RECREATION AREA, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02388

SELECTED HYDROLOGIC DATA FOR THE SOUTH PLATTE RIVER THROUGH DENVER, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02391

HYDROLOGY OF YUCCA MOUNTAIN AND VICINITY, NEVADA-CALIFORNIA--INVESTIGATIVE RESULTS THROUGH MID-1983,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02413

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

USDA PLANNING PROCESS FOR COLORADO RIVER BASIN SALINITY CONTROL,
Soil Conservation Service, Portland, OR. West National Technical Center.
For primary bibliographic entry see Field 5G.
W86-02270

PLANNING AND IMPLEMENTATION FRAMEWORK FOR SALINITY CONTROL IN THE INDUS RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5G.
W86-02272

SALINITY CONTROL ON THE SMOKY HILL RIVER IN CENTRAL KANSAS,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5G.
W86-02301

6B. Evaluation Process

PROJECTING LAND USE CHANGES ASSOCIATED WITH SMALL WATERSHED DEVELOPMENT,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 6G.
W86-01976

ECONOMIC EVALUATION OF SALINITY CONTROL,
Corps of Engineers, Tulsa, OK.
R. D. Brown.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 125-134, 2 fig. 2 ref.

Descriptors: *Saline water, *Salinity, *Desalination, Water requirements, Water users, Water use, *Red River, Economic aspects.

The methodology used to determine the economic merit of investment for removal of salt pollution in the Red River is described. The primary points of evaluation include: existing water uses, existing water sources, future municipal water demands, future industrial water demands, alternative water sources to meet future demands, and finally, the cost of Red River water. The results of these evaluations show that the Red River chloride control project should be constructed and that the estimated benefit-to-cost ratio is 1.6 to 1. (Halterman-PTT)
W86-02275

PROCESS OF PROJECT PREPARATION,
Walker and Partners Ltd., Ottawa (Ontari).
B. Grover.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 269-285, 2 fig, 6 ref.

Descriptors: *Project planning, *Sanitation, *Water supply development, *Decision making, *Feasibility studies, Future planning, Evaluation, Planning, Financing, Management planning, Financial feasibility, Water supply, Projections, Benefits.

The basic factors involved in the preinvestment planning of water supply and sanitation development projects are reviewed. A brief report suffices to identify a possible project and commence the preinvestment planning. The prefeasibility study aims to select a preferred project for near term implementation after considering longer-term needs, existing system deficiencies and alternative system development. International financing agencies normally require general data on how the water supply and sanitation sector is organized throughout the country, and on how effectively services are currently provided and on national goals concerning water supply and sanitation services. The rationale for proceeding to develop a project must be explained carefully. Separate plans should be prepared for the phased development of water supply and sanitation systems to meet projected needs in the project area throughout the planning period. The prefeasibility stage should reach certain conclusions and recommend future actions, including the preparation of selected projects in a comprehensive feasibility study. The feasibility stage is the last stage before a project is approved and funds are committed. The feasibility report should provide data on the proposed project, institutional and financial aspects, and project impacts and justification. Resources for project preparation are discussed. Project approval usually depends on the consensus of several interest groups. (Geiger-PTT)
W86-02339

OPERATION AND MAINTENANCE OF WATER SUPPLY AND SANITATION SYSTEMS,
Walker and Partners Ltd., Ottawa (Ontari).
For primary bibliographic entry see Field 5D.
W86-02341

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

EVOLUTION OF A COST SHARING POLICY FOR FEDERAL CHLORIDE PROJECTS,
Army Engineer Div. Southwestern, Dallas, TX.
H. G. Robinson, and R. R. De Bruin.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 23-32, 1 fig, 1 tab, 5 ref.

Descriptors: *Saline water, *Salinity, Irrigation, Water requirements, Water supply, Water use, Water users, Arkansas River, Kansas, Oklahoma, Arkansas, Red River, Texas, Brazos River Basin, Cost sharing, Economic aspects.

The 20-year evolution of the cost-sharing rationale of the control of chlorides from natural sources is discussed. The financing involves several levels of the Federal government and the particular states that are involved. The major factors that influence any cost-sharing rationale include precedents (similarity of project to others with established cost-sharing policies), national objectives, state of the economy, recent laws or policies, and the logic of the new cost apportionment proposal. Specific natural sources of salt that are discussed include the Arkansas and Red Rivers and the Brazos River basin. The general cost-sharing rationale is summarized as follows. From 1961-1963, 100% of chloride control was paid for by the Federal Interstate Water Quality Project. In following years, the federal government paid from zero to 75% of costs. In 1977-1980, 100% of costs were paid by non-federal government agencies. In recent years the federal government has provided substantial reimbursements to non-federal agencies. (Halterman-PTT)
W86-02266

WATER SUPPLY AROUND THE WORLD--APPROPRIATE TECHNOLOGY,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W86-02325

COST-EFFECTIVE WATER SUPPLY AND SANITATION PROJECTS FOR DEVELOPING COUNTRIES,
International Bank for Reconstruction and Development, Washington, DC. Dept. of Transportation and Water.
F. L. Golladay.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 221-249, 2 fig, 3 tab, 1 ref, 3 append.

Descriptors: *Cost analysis, *Cost-benefit analysis, *Water supply development, *Sanitation, *Developing countries, Economic aspects, Project planning, Water supply, Costs, Econometrics, Economic evaluation.

This chapter suggests how needs for water supply and waste disposal can be met as sharply reduced costs. The economist is charged with the responsibility of cost-effectiveness and cost-benefit analysis of development projects. The value of benefits is generally difficult to quantify. The accounting of costs is usually incomplete. The value attached to inputs frequently bears little relationship to their social opportunity costs. Where surface water is uncontaminated and continuous, it offers the least costly option for water supply. Groundwater supplies are inexpensive when they can be drawn by hand with rope and bucket. The major issue in urban water supply projects is the type of delivery system to be installed. Waterborne sewerage provides not only health and environmental benefits, but very high consumer convenience. Examples of least-cost analyses of water supply and sanitation systems are presented. The initial choice of technology to improve sanitation should also reflect the desire for future improvements. The purpose of determining economic costs is to provide the basis for meaningful least-cost comparisons among alternatives. Unless substantial subsidies are feasible, low income consumers can afford only the cheapest of the low-cost options. A government might attach top priority for sanitation development to areas where the burden of disease is greatest. Appendices dicuss the use of shadow pricing in cost analysis, costs of alternative water supply and sanitation service levels, and alternative service levels for urban water supply. (Geiger-PTT)
W86-02337

FINANCING WATER SUPPLY SYSTEMS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. A. Okun.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 251-267, 6 fig, 10 ref.

Descriptors: *Economic aspects, *Water supply, *Financing, *Water costs, *User charges, Cost analysis, Water supply development, Sanitation, Developing countries, Project planning, Costs, Economic evaluation.

Financing of a system of water supply by the user is needed to provide the user with a sense of the value of the system and help assure its proper operation and maintenance. The income will help defray at least the cost of operation and maintenance and provide funds for expansion of the system as needed. If local participation in financing is needed to assure success of a water supply project, then local initiative and collaboration in the planning and implementing of the project should also be included. Methods of collection of fees for water include residential metering, and metering at roadside standpost water supplies. Another less costly option that may delay metering is the use of flow restrictors or Fordillas. Water vending by individuals or by the government is often practiced in cities and villages not served by piped systems. Financing affects the design of water supply systems in terms of facility size and the availability of funds for capital and manpower in the face of massive needs. If a long-term and continuing investment in water supply and sanitation systems is to be assured for those curently being served and for the large percentage of the population not yet being served, financing systems need to provide sufficient funds, not only for payment of current operation and maintenance costs, but for repayment of capital costs. (Geiger-PTT)
W86-02338

6D. Water Demand

WATER USE IN OHIO, 1980,
Geological Survey, Columbus, OH. Water Resources Div.
M. Eberle, and J. A. McClure.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4024, 1984. 35 p, 5 fig, 7 tab, 28 ref.

Descriptors: *Water use, Industrial water, Thermal powerplants, Municipal water, Livestock, Rural areas, *Ohio.

An estimated 13,389 million gallons of water per day were used in Ohio in 1980, in four major categories of water use. Of this total, 12,645 Mgal/d (million gallons per day) were taken from surface-water sources whereas 744 Mgal/d was ground water. Totals for each category (in Mgal/d) were: thermoelectric power generation, 10,417; self-supplied manufacturing, 1,399; public water supplies, 1,432; and rural domestic and livestock, 141. Additional miscellaneous uses (irrigation, rural commercial, and non-manufacturing industrial) probably totaled about 300 Mgal/d. The five counties that led the state in total water use were: Jefferson, 2,620 Mgal/d; Lucas, 1,150 Mgal/d; Gallia, 1.086 Mgal/d; Cuyahoga, 1,085 Mgal/d; and Lorain, 991 Mgal/d. These counties, in the same order, were the top five surface-water users. (USGS)
W86-01954

ESTIMATE OF SELF-SUPPLIED DOMESTIC WATER USE IN OKLAHOMA DURING 1980,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. D. Stoner.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4223, 1984. 20 p, 7 fig, 4 tab, 7 ref.

Descriptors: Water supply, *Water utilization, Domestic water, *Oklahoma, *Water use.

Reported or measured water-use data for the domestic self-supplied user were not available for the state of Oklahoma; therefore, estimates of water use within this classification were derived. The total self-supplied population in Oklahoma during 1980 was estimated at 343,615, which was 11.4 percent of the total 1980 State population. The rate of water use by this group was estimated to be 56 gallons per capita per day. For 1980, the estimated annual domestic self-supplied water use by county ranged from 10 to 1,180 acre-feet, with a total statewide use of 21,610 acre-feet. (USGS)
W86-02380

6E. Water Law and Institutions

OVERVIEW OF THE LEGAL, POLITICAL, AND SOCIAL IMPLICATIONS OF WASTEWATER TREATMENT THROUGH AQUACULTURE,
Denver Research Inst., CO.
For primary bibliographic entry see Field 5D.
W86-02068

EFFECTS OF FEDERAL REGULATIONS ON WATER TREATMENT PLANT DESIGN,
Environmental Protection Agency, Denver, CO. Region VIII.
For primary bibliographic entry see Field 5F.
W86-02189

WHAT IS THE MOST EFFECTIVE WATER POLICY FOR THE UNITED STATES: NATIONAL DEBATE TOPIC FOR HIGH SCHOOLS, 1985-1986,
Library of Congress, Washington, DC. Congressional Research Service.
Pursuant to Public Law 88-246, Senate, 99th Congress: 1st Session, Document No. 99-2, 1985. 957 p, 169 ref.

Descriptors: *Planning, *Water law, *Water policy, *Water supply, *Water quality, Federal jurisdiction, Water resources development, Water management, Institutional constraints, Water rights, Legal aspects, Water transfer, Wastewater treatment, Potable water, Drinking water.

Resource material for a national debate topic for high schools (1985-1986) consists of published papers, a bibliography, and guide to information sources, including government publications. The book is divided into chapters on background materials and the three debate propositions: (1) Resolved: that the federal government should implement a national system of priorities to control the allocation of all water in the United States, (2) Resolved: that the federal government should establish a comprehensive national policy to protect the quality of water in the United States, and (3) Resolved: that the federal government should establish a national policy to insure each United States resident an adequate supply of potable water for personal use. (Cassar-PTT)
W86-02218

LEGAL AND INSTITUTIONAL CONSTRAINTS TO SALINITY CONTROL,
Bureau of Reclamation, Provo, UT. Utah Projects Office
J. Franson, and M. Lopez.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 55-61, 6 ref.

Descriptors: *Salinity, *Saline water, Irrigation, Irrigation procedures, Water requirements, Irrigation requirements, Water supply, Water use, Water users, Colorado River, Colorado River Basin.

A variety of constraints to salinity control in the Colorado River are reviewed. General constraints that are discussed include the local perception that salinity control benefits only the lower Colorado Basin at the expense of the upper Basin, and, the perception by the federal government that the problem is regional and should be solved by the Basin states. Further constraints that are discussed include a lack of urgency at both the local and national level, and a lack of coordination in funding between the Bureau of Reclamation and the Soil Conservation Service. Possible options for slowing down the projected increases of salinity concentrations are discussed. They fall into three categories: prevent saline waters from entering the River, reduce salt pickup of waters entering the River, and provide extra water for dilution of salinity.
W86-02269

SALINITY BUBBLES AND OFFSETS: A CONCEPT PAPER,
Environmental Protection Agency, Denver, CO. Water Management Div.
For primary bibliographic entry see Field 5G.
W86-02271

WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES,
For primary bibliographic entry see Field 5F.
W86-02324

WATER SUPPLY AROUND THE WORLD--APPROPRIATE TECHNOLOGY,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W86-02325

REGIONALIZATION OF WATER SUPPLY AND SANITATION SERVICES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W86-02326

6F. Nonstructural Alternatives

EVALUATION OF COMMUNITIES FOR THE APPLICATION OF LIMITED-DETAIL STUDY METHODS FOR FLOOD-INSURANCE STUDIES,
Geological Survey, Reston, VA. Water Resources Div.
E. D. Cobb.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4098, 1985. 54 p, 3 fig, 3 tab.

Descriptors: *Floods, *Flood discharge, Flood plain management, *Flood profiles, *Flood routing, Maps, Insurance, *Flood insurance, Data collections, *Data program design, *Limited-detail flood-insurance studies, Historical floods, Depth-frequency studies, Evaluations.

The U.S. Geological Survey evaluated 2,349 communities in 1984 for the application of limited-detail flood-insurance study methods, that is, methods with a reduced effort and cost compared to the detailed studies. Limited-detail study methods were found to be appropriate for 1,705 communities, while detailed studies were appropriate for 62 communities and no studies were appropriate for 582 communities. The total length of streams for which limited-detail studies are recommended is 9,327 miles with a corresponding cost of $23,007,000. This results in average estimated costs for conducting limited-detail studies of $2,500 per mile of studied stream length. The purpose of the report is to document the limited-detail study methods and the results of the evaluation. (USGS)
W86-02373

6G. Ecologic Impact Of Water Development

APPEARANCE AND WATER QUALITY OF TURBIDITY PLUMES PRODUCED BY DREDGING IN TAMPA BAY, FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
C. R. Goodwin, and D. M. Michaelis.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Supply Paper 2192, 1984. 66 p, 47 fig, 20 tab, 41 ref.

Descriptors: *Estuaries, *Dredging, *Water quality, *Aerial photography, *Florida, Turbidity, Nutrients, Metals, Pesticides, *Tampa Bay, *Turbidity plumes.

Turbidity plumes in Tampa Bay, Florida, were photographed and sampled during ship-channel dredging operations from February 1977 to August 1978 to document plume appearance and water

quality. Color photographs depict plumes ranging in length from tens of meters to several kilometers with turbidity levels from less than 10 to 200,000 Nephelometric Turbidity Units. Sediment composition varied from 85 percent sand and shell to 60 percent silt and clay. Plumes from one hopper dredge and three cutterhead-pipeline dredges were investigated. Disposal methods included beach nourishment, stationary submerged discharge, oscillating surface discharge, and creation of emergent dikes using turbidity barrier containment. Tidal velocities ranged from zero to 0.60 meters per second. Primary turbidity plumes were created directly by dredging and disposal operations and secondary plumes were created indirectly by resuspension of previously deposited material. The most visible turbidity plumes resulted from surface discharge to unconfined disposal areas of material having relatively high sand content discharging during times of strong tidal currents. Changes were not detected in nutrient, metal, and pesticide concentrations in Tampa Bay due to dredging. Few long-term turbidity characteristics of Tampa Bay could be directly attributed to dredging operations. (USGS)
W86-01929

CHEMICAL QUALITY OF WATER AT 14 SITES NEAR KESTERSON NATIONAL WILDLIFE REFUGE, FRESNO AND MERGED COUNTIES, CALIFORNIA,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01959

PROJECTING LAND USE CHANGES ASSOCIATED WITH SMALL WATERSHED DEVELOPMENT,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
J. Kasal, and W. Crosswhite.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-149427, Price codes: A03 in paper copy, A01 in microfiche. ERS Staff Report No. AGES820330, April 1982. 47 p, 5 fig, 8 tab, append.

Descriptors: *Small watersheds, *Land use, *Projections, *Water resources development, *Statistical methods, Aerial photography, Markov process, Mathematical studies, Evaluation, Project planning.

This study determines if projected land use changes and their benefit estimates are biased in favor of project development. Both the base period land use estimates and the projected land use changes in a sample of 40 projects in two contrasting geographical regions were found to be reliable. When observed land use changes are measured from aerial photographs, the differences between projected and observed land use changes were not statistically significant. Four alternative land use projection techniques - aerial photography, trend analysis, cooperative river basin study procedures and the Markov process - did not improve upon the reliability of the U.S. Department of Agriculture Soil Conservation Service (SCS) land use projections. The SCS land use projection procedures for small watershed areas are set forth in the Economics Guide. Farm surveys are used to collect land use data for planning and evaluation of small watershed projects. The SCS land use projection procedures provide reliable measures of land use trends for estimating land use benefits due to project measures. (Geiger-PTT)
W86-01976

PATTERNS IN PREHISTORIC SETTLEMENT: EXAMINING THE DISTRIBUTION OF SITES IN A PORTION OF THE COLORADO RIVER VALLEY,
New World Research, Inc., Tucson, AZ.
Report of Investigations No.83-11, 1984. Compiled by John E. Keller, and L. Janice Campbell. Bureau of Reclamation, Amarillo, TX. 259 p, 64 fig, 23 tab, 6 app, 137 ref.

Descriptors: *Environmental effects, *Water resources development, *Archeology, Columbus Bend Dam, *Texas, Colorado River, Colorado Coastal Plains Project.

A cultural resources investigation of the proposed Columbus Bend Dam and Reservoir in Colorado and Fayette counties, Texas, revealed 96 sites. These were dominated by prehistoric lithic scatters. Lithic-ceramic scatters, stratified prehistoric sites, and historic sites were also identified. The work produced a predictive model of site location and interpretation of site data in light of cultural patterns and influences in settlement. (Cassar-PTT)
W86-01991

INDIAN LAND USE AND OCCUPANCY IN THE FRANKLIN D. ROOSEVELT LAKE AREA OF WASHINGTON STATE,
R. Bouchard, and D. Kennedy.
Colville Confederated Tribes, Nespelem, WA. June 1984. 456 p, 129 fig, 234 ref.

Descriptors: *Environmental effects, *History, *Land use, Indians, Franklin D. Roosevelt Lake, Washington, Columbia River.

Indian land use and occupancy were studied in Franklin D. Roosevelt Lake, Washington, the area along the Columia River between Grand Coulee Dam and the Canadian border. Elderly Indian informants and archives yielded 408 place names. For each place name are given the associated legends, meaning of the name, and activities. A comprehensive history of land utilization in Sanpoil, Spokane, Colville, and Lakes Indian territories traces events starting with the fur trading era. Information about hunting, fishing, plant food gathering, intergroup relations and territories is most abundant for the Sanpoil people. Little details are available for the Lakes and Colville peoples. However, some generalizations, common to all fishing-hunting-gathering people, can be made. (Cassar-PTT)
W86-01992

POTENTIAL CONSEQUENCES OF REJECT STREAM REPLACEMENT PROJECTS ON AQUATIC, TERRESTRIAL, AND RECREATION RESOURCES: VOLUME II, AQUATIC RESOURCES,
Engineering-Science, Inc., Arcadia, CA.
U.S. Bureau of Reclamation, Boulder City, NV. February 1980. 219 p, 33 fig, 21 tab, 4 append.

Descriptors: *Environmental effects, *Wildlife, *Fish, *Aquatic habitats, Yuma Desalting Plant, Butler Valley, Arizona, Imperial Valley, California, Alamo River, Salton Sea, All-American Canal, Santa Clara Slough, Aquatic plants, Aquatic animals, Aquatic life, Habitats, Marshes, Salt marshes, Canals, Rivers, Invertebrates, Streams, Brines, Desalination.

Effects on aquatic resources are discussed for several proposed projects for replacing the 44,000 acre-feet/year of brine flow rejected from the Yuma Desalting Plant. Proposed locations for these projects are the Imperial Valley, California, or Butler Valley, Arizona. Water systems affected by the projects include the All-American Canal, Alamo River, Salton Sea, Santa Clara Slough, and Butler Valley. For each system the following were determined: channel features, hydrology, water quality, substrates, underwater cover, and aquatic life (fish, algae, macrophytes, invertebrates, amphibians, and reptiles). The All-American Canal, impacted only in the 43.5-mile reach from Pilot Knob to East Highline Canal, supports a large gamefish population which is not widely fished. The Alamo River is not a good fishery, because of a small fish populaiton and concern over bacterial and pesticide contamination. The saline Salton Sea at Wister has only three macroinvertebrates (pile worms, barnacles, and amphipods) and three gamefish species. The Santa Clara Slough, a small salt marsh, contains 14 species of salt water fish and a variety of fish-eating birds. The Butler Valley in Arizona has no perennial streams or standing waters, only desert washes. Groundwater is abundant at depths of 100-500 feet. (Cassar-PTT)
W86-01994

CLASS III SURVEY OF THE TUCSON AQUEDUCT PHASE A CORRIDOR, CENTRAL ARIZONA PROJECT: AN INTENSIVE ARCHAEOLOGICAL SURVEY IN THE LOWER SANTA CRUZ RIVER BASIN, PICACHO RESERVOIR TO RILLITO, ARIZONA,
Arizona State Museum, Tucson. Cultural Resource Management Div.
Archaeological Series 165, January 1984. Compiled by Jon S. Czaplicki. 286 p, 136 fig, 64 tab, 201 ref, 5 append. 0-07-30-X0091.

Descriptors: *Environmental effects, *Archeology, Water resources development, Right-of-way, Aqueducts, *Central Arizona Project, *Tucson Aqueduct, *Arizona, Aqueducts, Santa Cruz River.

A Class III intensive survey of 42 miles (about 9753 acres) of Phase A of the Tucson Aqueduct, Central Arizona Project, was conducted between June 7 and October 15, 1982. Seventy-eight prehistoric and eight historic sites were recorded. Twenty-one of the prehistoric sites are Archaic sites or are sites with an Archaic component. These sites, in addition to numerous isolated projectile points, indicate a potentially extensive Archaic occupation of the study area. The 57 Hohokam sites include three Classic period communities, one in each reach and each one apparently centered on a platform mound complex. The platform mound on Brady Wash in Reach 1 lies just outside the aqueduct right-of-way. Several Preclassic sites were also identified in Reaches 1 and 2, including a reservoir in Reach 2. The 1982 survey identified a previously undocumented Archaic occupation and a much more extensive Preclassic and Classic Hohokam occupation in the Lower Santa Cruz River Basin north of Tucson and south of Florence, Arizona. This area had received relatively little attention by archaeologists until the investigation carried out as a result of construction of the Tuscon Aqueduct. (Author)
W86-01995

POTENTIAL CONSEQUENCES OF REJECT STREAM REPLACEMENT PROJECTS ON AQUATIC, TERRESTRIAL, AND RECREATION RESOURCES: VOLUME III, TERRESTRIAL RESOURCES,
Engineering-Science, Inc., Arcadia, CA.
U.S. Bureau of Reclamation. Boulder City, NV. February 1980. 329 p, 23 fig, 15 tab, 4 append.

Descriptors: *Environmental effects, *Vegetation, *Wildlife, Habitats, Mammals, Birds, Reptiles, Amphibians, Plant populations, Yuma Desalting Plant, Butler Valley, *Arizona, Imperial Valley, *California, Alamo River, Salton Sea, All-American Deserts, Arid lands, Brines, Desalination.

Effects on terrestrial resources are discussed for several proposed projects for replacing the 44,000 acre-feet/year of brine flow rejected from the Yuma Desalting Plant. Proposed locations for these projects are the Imperial Valley, California, or Butler Valley, Arizona. Vegetation and wildlife characteristics are reported for both areas. The Imperial Valley has nine types of communities from wetlands and river riparian to cresote bush and sand dunes. The animal population (54 species of mammals, 297 species of birds, 42 species of reptiles and amphibians) features several special interest birds and reptiles. The major concern is the rare black rail and the endangered Yuma clapper rail, which would be severely threatened by the wetlands elimination. The mammal population is comprised of few game mammals but many furbearers and rodents. Waterfowl are abundant. Butler Valley is a sparsely settled, productive desert community is the most attractive wildlife habitat. Five endangered or threatened wildlife species are found in the Butler Valley: peregrine falcon, desert bighorn, zone-tailed hawk, desert tortoise, and Gila monster. Ten species of blue list birds (not endangered in the study area, but scarce in other areas of the U.S.) live in this valley. (Cassar-PTT)
W86-02011

FLUCTUATING WATER LEVELS IN RESERVOIRS; AN ANNOTATED BIBLIOGRAPHY

ON ENVIRONMENTAL EFFECTS AND MANAGEMENT FOR FISHERIES,
Fish and Wildlife Service, Fayetteville, AR.
For primary bibliographic entry see Field 10C.
W86-02033

WATER QUALITY, MACROINVERTEBRATES, AND FISHERIES IN TAILWATERS AND RELATED STREAMS: AN ANNOTATED BIBLIOGRAPHY,
Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
For primary bibliographic entry see Field 10C.
W86-02035

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS, REPORT 2: FIRST YEAR POSTSTOCKING RESULTS,
Florida Game and Fresh Water Fish Commission, Orlando.
S. Hardin, R. Land, G. Morse, and M. Spelman.
Volume II: The Fish, Mammals, and Waterfowl of Lake Conway, Florida, Technical Report A-78-2, February 1982. Report 2 of a Series. Army Engineer Waterways Experiment Station, Vicksburg, MS. 70 p, 15 fig, 9 tab, 55 ref, append. DACW39-76-C-0081.

Descriptors: *Aquatic weed control, *Aquatic weeds, *Biological control, White amur, Fish diets, Waterfowl, Aquatic mammals, Lake Conway, *Florida.

Fish, waterfowl and wading birds, and aquatic mammal populations on Lake Conway, Orange County, Florida were surveyed for one year after the introduction of the herbivorous fish, white amur (Ctenopharyngodon idella). Fish populations were sampled by Wegener ring, seine, gill nets and electrofishing. Standing crop estimates were made with blocknet and rotenone collections. The sportfishery was measured by creel surveys. Waterfowl were observed and counted from an airboat, and collected by shotgun. Aquatic mammals were collected by a variety of traps. Low water levels reduced littoral zone area, which lead to stunted panfish and poorer condition of largemouth bass. Vegetated samples supported more diverse fish populations than beach sites. White amur and migratory waterfowl consumed the same plant foods; continued reduction of submerged plants by white amur may adversely affect overwintering waterfowl populations. Aquatic mammals were influenced by removal of vegetation due to shoreline development. (Author's modified abstract)
W86-02037

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS, REPORT 2: FIRST YEAR POSTSTOCKING RESULTS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
T. L. Crisman, and F. M. Kooijman.
Volume III: The Plankton and Benthos of Lake Conway, Florida, Technical Report A-78-2, November 1981. Report 2 of a Series. Army Engineer Waterways Experiment Station, Vicksburg, MS. 53 p, 28 fig, 4 tab, 22 ref.

Descriptors: *Aquatic weed control, *Aquatic weeds, *Biological controls, White amur, Phytoplankton, Zooplankton, Lake Conway, Florida, Benthic fauna.

After the stocking of Lake Conway, Florida, with white amur to control aquatic vegetation, studies on the effects on plankton, benthos and zooplankton were conducted. Major fluctuations in plankton, benthos and zooplankton communities confounded the determination of the effects of white amur introduction. Further long-term studies are needed to determine the effectiveness and overall impact of introducing white amur for macrophyte control. The results are based on analyses of data on physical-chemical parameters, plant pigments, and abundance and species composition of phytoplankton, zooplankton and benthic macroinvertebrates. (Halterman-PTT)
W86-02038

ASSESSING AND MANAGING EFFECTS OF REDUCED FRESHWATER INFLOW TO TWO TEXAS ESTUARIES,
National Coastal Ecosystems Team, Slidell, LA.
N. A. Funicelli.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 435-446, 2 tab, 7 ref.

Descriptors: *Enviromental effects, *Estuaries, *Management, *Filtration, Coastal zone management, Wildlife, Fish, Nutrients, Marshes, Floods, Nueces River, Corpus Christi Bay, Matagorda Bay, Rivers, Saline water, Aquatic habitats, Habitats, Organic carbon, Phosphorus, Nitrogen, Deltas, Wastewater disposal, *Texas.

While a major objective of coastal zone management plans is to maintain the value and use of estuaries, decisions affecting inflow, a critical component of estuaries, are often based on considerations of water use inland. The functions of estuaries as filters for inland based signals is often ignored. For effective manasagementof both inlandwater resources and estuarine freshwater inflow, methods for assessing the actual effects of inland perturbations are needed. Because no single method exists, the U.S. Fish and Wildlife Service used a set of evaluative methods to assess the effects of reduce freshwater inflow on estuaries in Nueces-Corpus Christi and Matagorda Bays and to develop management plans for ensuring fish and wildlife productivity. The set included (1) studying the effects of environmental changes on key species, (2) regression analysis between inflow and fishery harvest data, (3) compilation and analysis of a nutrient budget, and (4) comparison of historical and projected deltaic marsh inundations. Proposed management plans to address the findings of these assessment methods involved the release of freshwater during spring and low inflow, the rerouting of selected wastewater to the river delta, and the diversion of in-channel water to inundate deltaic marshes. These plans all depend upon compromises between inland and coastal needs. (Author)
W86-02090

DETERIORATION OF COASTAL ENVIRONMENTS IN THE MISSISSIPPI DELTAIC PLAIN: OPTIONS FOR MANAGEMENT,
Louisiana Universities Marine Consortium, Chauvin.
D. F. Boesch, J. W. Day, and R. E. Turner.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 447-466, 2 fig, 1 tab, 34 ref. 14-16-0009-81-1016.

Descriptors: *Environmental effects, *Estuaries, *Deltas, *Management, *Mississippi River, *Louisiana, Channeling, Wetlands, Marshes, Canals, Dredging, Coastal zone management, Aquatic habitats, Habitats, Saline water, Water diversion, Sediment transport.

Coastal environments in the Mississippi Deltaic Plain of southeastern Louisiana are undergoing rapid change as a result of natural decay of Mississippi delta lobes, channelization of river flow, and dredging activities. As a result, over 100 sq km per year of coastal wetlands are converted to open water or uplands--85% of the total U.S. loss rate. Of the options available to reduce the deterioration of coastal wetlands, management of new delta accretion and regulatory control and rehabilitation of channelized wetlands are likely the most effective. Attempts to stabilize coastal barriers should also be made because of the potential for very rapid erosion in their absence. Controlled diversions of the river above the active deltas will be limited in capacity by the presence of populated areas and roads are unlikely to contribute significantly to new wetland accretion. (Author)
W86-02091

IMPACT OF RESERVOIRS ON SEASONAL AND HISTORICAL SALINITY OF THE COLORADO RIVER,
Bureau of Reclamation, Salt Lake City, UT.
For primary bibliographic entry see Field 5B.
W86-02279

HISTORICAL TRENDS IN CONCENTRATION AND LOAD OF MAJOR IONS IN THE COLORADO RIVER SYSTEMS,
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 5B.
W86-02280

FISH AND WILDLIFE MITIGATION PROGRAM FOR THE COLORADO RIVER BASIN SALINITY CONTROL PROJECT - A CASE HISTORY,
Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
For primary bibliographic entry see Field 5G.
W86-02312

POTENTIAL FOR INTRODUCTION OF THREE SPECIES OF NONNATIVE FISHES INTO CENTRAL ARIZONA VIA THE CENTRAL ARIZONA PROJECT - A LITERATURE REVIEW AND ANALYSIS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
S. J. Grabowski, S. D. Hiebert, and D. M. Lieberman.
Report REC-ERC-84-7, June 1984. 124 p, 8 fig, 48 tab, 316 ref.

Descriptors: *Environmental impact statement, *Tilapia, *Bass, Environmental effects, *Pumping plants, *Food chains, Fish, Fish populations, Water resources development, Water quality, Ecological effects, Fisheries, Rivers, Lakes, Eagles, Birds.

During operation of the Central Arizona Project (CAP) which is designed to deliver allocated Colorado River water to central and southern Arizona, fish will be pumped from Lake Havasu to central Arizona receiving waters. The life history characteristics of three fish species, water quality aspects of CAP source and receiving waters, the existing fisheries of CAP sources and receiving waters, physical features of pumping plants, and some life history phenomena of the southern bald eagle are documented. Striped bass and blue tilapia may have an adverse impact on the existing fishery of Lake Pleasant. These two species and the white bass are suspected of having an adverse impact on the ecology of the Salt and Verde Rivers. If blue tilapia enter Lake Pleasant, they will likely survive and reproduce while striped bass will be much less likely to reproduce. Recruitment by introduction would continue to occur. If these fish become established and their numbers are not controlled by predators or environmental pressures, they could have an impact on the fish food base of the southern bald eagles along these rivers. (Geiger-PTT)
W86-02322

MORMON CARTER CLASS III CULTURAL RESOURCE SURVEY,
Bureau of Reclamation, Denver, CO. Lower Missouri Region.
S. R. Bradley, and M. Musitelli.
September 1984. 103 p, 53 fig, 28 ref, 2 append.

Descriptors: *Environmental effects, *Archeology, Mormon Carter Transmission Line, Fryingpan River, Colorado, Water resources development, Water transfer.

The Lower Missouri Region of the Bureau of Reclamation conducted a Class III cultural resources survey of the Mormon Carter Transmission Line in the North Fork Fryingpan River drainage, Pitkin County, Colorado. Four prehistoric sites and three historic sites were recorded during the survey. Manifestations of cultural behavior resulting from a lifeway of prehistoric, seasonal resource exploitation are contrasted to the manifestation resulting from a historic sedentary adaptation. The presence of a possible Rose Spring Corner Notched projectile point indicates human utilization of the North Fork drainage from at least

300 A.D. to the present. Five sites are recommended for avoidance or mitigation. The possible presence of subsurface deposits at these sites suggests eligibility to the National Register of Historic Places. (Author)
W86-02323

7. RESOURCES DATA

7A. Network Design

EVALUATION OF THE SURFACE-WATER DATA NETWORK, SUWANNEE RIVER BASIN, FLORIDA, 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. P. Rumenik, and J. E. Coffin.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4245, 1984. 22 p, 5 fig, 2 tab, 17 ref.

Descriptors: *Surface waters, *Gaging stations, *Water management, Flow characteristics, River forecasting, Flood profiles, Low flow, *Florida, *Suwannee River basin, Surface-water data network.

In the 9,950 square mile area of the Suwannee River basin in Florida and Georgia, a network of 33 surface-water gaging stations operated for different periods of time from 1927 to 1982 was evaluated for its capability to provide program information for floodplain mapping, floodplain management, forecasting of flow extremes, and defining the impact of changes in land use on surface-water quantity and quality. Gaging stations are classified based on the type of data and number of years record as current use, long-term trend, and planning and design. Goals are established for each classification. Suggestions for program revisions include establishing crest-stage gages for high-flow and flood-profile data, defining and establishing a low-flow network, and establishing two and discontinuing one daily discharge station. (USGS)
W86-01936

GROUND-WATER-QUALITY MONITORING NETWORK DESIGN FOR THE SAN JOAQUIN VALLEY GROUND-WATER BASIN, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
W. E. Templin.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Inbvestigations Report 83-4080, 1984. 133 p, 19 pl, 7 fig, 6 tab, 131 ref.

Descriptors: Groundwater, Water quality, *Network design, Geology, Land use, *Water pollution sources, *Nonpoint pollution sources, Groundwater levels, *Groundwater quality, *Groundwater pollution, *California, Point sources, San Joaquin Basin, Tulare Basin, Sacramento-San Joaquin Delta, Pesticides (DBCP), Pesticides, Regional network design.

This report proposes ideal and actual groundwater-quality monitoring networks for the San Joaquin Valley basin, California. The report outlines an ideal network, comprising several subnetworks, to provide direction in development of actual networks composed of wells currently (1981) known to be monitored. The ideal network serves as a basis for future expansion of the actual networks as more wells are included in the inventory of active monitoring networks. The management objectives of these networks are to develop a general baseline of ground-water quality, to identify trends in ground-water quality, and to identify sources of contamination. The networks are based on an information structure that includes land use, surface and subsurface geology, ground-water levels, surface- and ground-water quality, possible sources of contamination, and active ground-water-quality monitoring networks. Development of the categories and subcategories of network objectives, which are needed to describe the quality of ground water in the basin, make clear the inadequacy of the currently operated networks. The expansion of ground-water-quality monitoring in the San Joaquin Valley, therefore, would be necessary to approximate the objectives of the ideal network. (USGS)
W86-01953

COST-EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY STREAM-GAGING PROGRAM IN ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
M. E. Darling, and T. E. Lamb.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4084, 1984. 91 p 10 fig, 13 tab, 23 ref.

Descriptors: *Surface water records, *Statistical analysis, Gaging, Gaging station, Network, Streamflow, *Stream gaging, *Arkansas, *Cost-effectiveness.

This report documents the results of the cost-effectiveness of the stream-gaging program in Arkansas. Data uses and funding sources were identified for the daily-discharge stations. All daily-discharge stations were found to be in one or more data use categories, and none were candidates for alternate methods which would result in discontinuation or conversion to a partial record station. The cost for operation of daily-discharge stations and routing costs to partial record stations, crest gages, pollution control stations as well as seven recording ground-water stations was evaluated in the Kalman-Filtering Cost-Effective Resource allocation (K-CERA) analysis. This operation under current practices requires a budget of $292,150. The average standard error of estimate of streamflow record for the Arkansas District was analyzed at 33 percent.
W86-01961

ENVIRONMENTAL 'TERMITE' INSPECTIONS,
For primary bibliographic entry see Field 5A.
W86-02223

ANNUAL AVERAGE CLIMATIC MAPS OF THE UNITED STATES,
National Climatic Data Center, Asheville, NC.
Environmental Information Summaries, C-21, September 1983. 10 p, 4 ref.

Descriptors: *Mapping, *Maps, *Climatology, *Meteorological data collections, *United States, Hydrologic maps, Precipitation, Relative humidity, Humidity, Solar radiation, Corrosion control, Data collections, Weather data collections, Dewpoint, Thunderstorms.

Several annual average climatic maps of the United States prepared by the National Climatic Data Center are presented. The maps may be applied to areas of allergy studies, corrosion protection requirement determinations, agriculture, and general climatology. Average annual map presentations in this edition are: temperature, 1941-1970; total precipitation (water equivalent), 1941-1970; relative humidity, generally 1948-1977; dew point temperature, generally 1946-1965; annual average daily global solar radiation on a south facing surface, generally 1953-1975; mean annual number of thunderstorms, generally 1948-1977; and normal annual heating degree days (contiguous United States and Alaska), generally 1951-1980. These climatic maps reflect average atmospheric conditions that occur over periods of years. Often, observed conditions for any given year will differ significantly from those indicated in the analyses. Caution should be used in interpolating on these generalized maps as sharp changes may occur in short distances, particularly in mountainous areas, due to differences in altitude, slope of terrain, type of soil, vegetation cover, bodies of water, air drainage, urban heat effects and other effects. Upon examination of mapped data, sulfur oxide emission densities were found to be correlated with corrosion potential. (Geiger-PTT)
W86-02321

ILLINOIS GROUND-WATER OBSERVATION NETWORK - A PRELIMINARY PLANNING DOCUMENT,
Geological Survey, Urbana, IL. Water Resources Div.
L. R. Frost, M. O'Hearn, J. P. Gibb, and M. G. Sherrill.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-584, 1984. 37 p, 11 fig, 1 tab, 28 ref.

Descriptors: *Groundwater, *Geohydrologic units, Groundwater levels, Water quality, Groundwater reservoirs, Network design, Networks, Data storage and retrieval, *Illinois, *Groundwater monitoring, Data management.

Water-level and water-quality networks in Illinois were evaluated to determine the adequacy and completeness of available data bases. Groundwater data in present data bases are inadequate to provide information on ground-water quality and water levels in large areas of Illinois and in the major geohydrologic units underlying Illinois and surrounding areas. Data-management needs indicate that a new data base is desirable and could be developed by use of carefully selected available data and new data. Types of data needed to define ground-water quality and water levels in selected geohydrologic units were tentatively identified. They include data on concentrations of organic chemicals related to activities of man, and concentrations of inorganic chemicals which relate either to man's activities or to the chemical composition of the source aquifer. Water-level data are needed which can be used to describe short- and long-term stresses on the ground-water resources of Illinois. Establishment of priorities for data collection has been deferred until existing hydrologic data files can be stored for usable data and until input from other local, State, and Federal agencies can be solicited and compiled. (USGS)
W86-02355

EVALUATION OF THE CREST-STAGE GAGE PROGRAM IN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
R. A. Herbert, D. D. Carlson, and G. J. Wiche.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4204, 1985. 24 p, 11 fig, 9 tab, 10 ref.

Descriptors: *Network analysis, *Network design, Crest gages, Annual runoff, Peak flow, Design floods, Index stations, Regression analysis, *Flood frequency, *Flood recurrence interval, Flood peak, Annual-peak discharge, Crest-stage gages, Flood-frequency equations, *Louisiana, Pine Hills Region.

The crest-stage gage program in Louisiana was evaluated to determine if the data were adequate for use in developing regional flood-frequency equations and to determine if any crest-stage gages could be discontinued. An abundance of data at many crest-stage stations and a lack of data for urban area and flat-slope areas indicated a need for a shift in the number, type, and locations of gages. Extensive correlations and comparisons of annual peak flows and watershed characteristics of 96 sites resulted in a reduced network of 25 stations that could potentially be used as index sites. The adequacy of the reduced network for development and verification of regional flood-frequency equations was tested by comparing a set of regional flood-frequency equations developed using data from the full network with a set developed using data from the reduced network. The results indicate that the crest-stage gage network can be reduced to 25 stations and still provide adequate information for future flood-frequency analyses. (USGS)
W86-02399

PRAGMATIC APPROACH TO EVALUATING A MULTIPURPOSE STREAM-GAGING NETWORK,

Geological Survey, Lakewood, CO. Water Resources Div.
K. L. Wahl, and J. R. Crippen.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water Resources Investigations Report 84-4228, 1984. 13 p, 1 fig, 2 tab, 6 ref.

Descriptors: *Network design, *Gaging stations, Streamflow, *Streamflow measurement, *Multipurpose networks, California.

A method for evaluating the relative worth of individual streamflow gaging stations in a multipupose network is presented. Each individual gaging station in the network is evaluated on the basis of selected rating factors. The factors relate to the need for information at the gaging stations, accuracy of data, economic aspects of operation, and usefulness of data as a basis for estimates at ungaged sites. The total score for the various factors provides a convenient basis for comparing relative importance of individual gaging stations. The rating-factor method is both flexible and definitive, but the point values that are assigned for each rating factor are somewhat subjective. A table of the point values and guidelines for assigning those values is presented. (USGS)
W86-02417

7B. Data Acquisition

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1984,
Geological Survey, Cheyenne, WY. Water Resources Div.
S. L. Green.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-622, 1984. 112 p, 4 fig, 5 tab, 6 ref.

Descriptors: *Water resources, *Hydrologic data, *Wyoming, Streamflow, Sediment load, Water quality, Groundwater, Water supply, Environmental effects, Oil shale, *Coal regions.

This report contains lists and location maps of streamflow and reservoir stations, crest-stage partial-record stations, water-quality stations, sediment stations, and ground-water observation wells that are currently being operated. Water-resources appraisal projects in Wyoming are also described, including many that are related to development of energy resources. The general locations of the projects are shown on maps. The U.S. Geological Survey is striving to coordinate its water-resources investigations with those of other agencies. This report is one phase of that coordination effort, and serves as an annual progress report to cooperators and the public. (USGS)
W86-01926

WIRELINE-ROTARY AIR CORING OF THE BANDELIER TUFF, LOS ALAMOS, NEW MEXICO,
Geological Survey, Lakewood, CO. Water Resources Div.
W. E. Teasdale, and R. R. Pemberton.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4176, 1984. 9 p, 4 fig, 3 ref.

Descriptors: Drilling, *Coring, *Air-rotary drilling, Disturbed geologic samples, Undisturbed geologic samples, Sampling, *Wireline coring, Corebit modifications.

This paper describes experiments using wireline-rotary air-coring techniques conducted in the Bandelier Tuff using a modified standard wireline core-barrel system. The modified equipment was used to collect uncontaminated cores of unconsolidated ash and indurated tuff at Los Alamos, New Mexico. Core recovery obtained from the 210-foot deep test hole was about 92 percent. A standard HQ-size, triple-tube wireline core barrel (designed for the passage of liquid drilling fluids) was modified for air coring as follows: (1) Air passages were milled in the latch body part of the head assembly; (2) the inside dimension of the outer core barrel tube was machined and honed to provide greater clearance between the inner and outer barrels; (3) oversized reaming devices were added to the outer core barrel and the coring bit to allow more clearance for air and cuttings return; (4) the eight discharge ports in the coring bit were enlarged. To control airborne-dust pollution, a dust-and-cuttings discharge subassembly, designed and built by project personnel, was used. (USGS)
W86-01934

ANNUAL SUSPENDED-SEDIMENT LOADS IN THE GREEN RIVER AT GREEN RIVER, UTAH, 1930-82,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-01935

THUDERSTORMS: A SOCIAL, SCIENTIFIC, AND TECHNOLOGICAL DOCUMENTARY. VOLUME 3: INSTRUMENTS AND TECHNIQUES FOR THUNDERSTORM OBSERVATION AND ANALYSIS.
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
For primary bibliographic entry see Field 2B.
W86-02003

STATION NETWORKS FOR STORM OBSERVATION,
National Weather Service, Sterling, VA. Test and Evaluation Div.
K. E. Wilk, and S. L. Barnes.
IN: Thunderstorms: A Social, Scientific, and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 1-31, 24 fig, 2 tab, 47 ref.

Descriptors: *Thunderstorms, *Meteorological data collections, *Radar, *Networks, *Data acquisition, Network design, Data collections, Weather data collections, Remote sensing, Reviews, Storms, Computers.

This chapter reviews the development of mesometeorological research networks and their instrumentation, and outlines some modern methods for data acquisition and analysis. The Thunderstorm Project in the 1940's was the first major national effort to collect data on thunderstorms. In 1955, the U.S. Army Signal Corps sponsored a reanalysis of the Thunderstorm Project and the data collection network was expanded. In the 1950's, the National Severe Storms Project (NSSP) was initiated within the U.S. Weather Bureau. In the early 1960's, the Air Force Air Weather Service and the Weather Bureau expanded their jointly operated Severe Local Storms Forecast Center to anticipate squall line development. Rapid improvement in research radars in the mid-1960's pointed the way to continuous, quantitative observations of storm development. By 1975, several low-cost devices became available to provide telemetry of analog data from remote sites to a central facility. By 1981, semiautomatic and automatic archiving and retrieval of meteorological data sensed at surface stations had become a standard practice. The objective map analysis method, a computerized method for analysis of spatially distributed time series observations, is described. The method is applied to surface, and upper-air data collected at an NSSP laboratory in central Oklahoma. (Geiger-PTT)
W86-02004

OBSERVATIONS FROM INSTRUMENTED AIRCRAFT,
National Oceanic and Atmospheric Administration, Boulder, CO. Weather Modification Program Office.
J. McCarthy, and D. L. Veal.
IN: Thunderstorms: A Social, Scientific, and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 47-76, 18 fig, 1 tab, 43 ref.

Descriptors: *Thunderstorms, *Radar, *Aircraft, *Aerial photography, *Meteorological data collections, Remote sensing, Lightning, Storms, Computers, Data acquisition, Storms, Weather data collections, Data collections.

Several major aircraft facilities exist which devote part of their efforts towards understanding the thunderstorm. Aircraft can serve as a direct in situ probe of thunderstorms whereas radar is indirect. Sensors that can be mounted on the aircraft are those that measure temperature, humidity, pressure, and air velocities. Observations of the cloud droplet spectrum are made by impactor sampling, optical devices, and electrostatic disdrometers. Liquid water content is calculated by summation of drop size spectrum or by direct bulk measurement techniques using evaporators, optical flow meters, transmissometers, microwave radiometers, paper tapes, synthetic filaments, and hot-wire total water indicators. Raindrop-sized hydrometeors can be measured by foil impaction, optical devices and momentum sensing. Ice crystals are collected by Formvar replication, on oil-coated slides, or are studied by optical techniques. Airborne radar can provide the aircraft crew with immediate thunderstorm data. Airborne computer-directed data systems are usually designed to operate for data acquisition, self-check or preflight-postflight program, and data processing. Chaff from aircraft has been used for radar jamming and lightning suppression. Examples are presented of cases where instrumented aircraft data have been combined with other direct and remote sensors to yield valuable data on thunderstorms. (Geiger-PTT)
W86-02005

PHOTOGRAMMETRY OF THUNDERSTORMS,
National Oceanic and Atmospheric Administration, Boulder, CO. Weather Modification Program Office.
R. L. Holle.
IN: Thunderstorms: A Social, Scientific, and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 77-98, 10 fig, 29 ref.

Descriptors: *Thunderstorms, *Clouds, *Photogrammetry, *Aerial photography, *Meteorological data collections, Photography, Data collections, Weather data collections, Storms, Tornadoes, Aircraft, Data acquisition.

Photogrammetry of every transient feature in thunderstorms is possible, but can be tedious. Mathematical equations which are used in conjunction with photogrammetry for determining cloud features are given. The simplest photographs of clouds are still photos taken by hand-held cameras. The next simplest system is the time-lapse movie camera which is usually focused on developing cloud systems. Panoramic photographs of the sky at fixed intervals provide benchmarks of cloud evolution in every direction from a single location. Multiple time-lapse camera photography of thunderstorms can be taken from either one or several locations with cameras usually unattended. Stereoscopic photographs afford a qualitative distance to clouds without any analysis. Analysis of airborne photos is more difficult than for those taken at ground level. Cloud maps can be developed from aircraft photos with the aid of lines drawn to connect the flight track to specific clouds when they are perpendicular to the side cameras and when they are at the azimuths corresponding to their entering, or leaving the side camera's view. Techniques for measuring widths and heights of clouds, and techniques for obtaining pictures from above thunderstorms are also discussed. (Geiger-PTT)
W86-02006

OBSERVATION AND MEASUREMENT OF HAILFALL,
National Center for Atmospheric Research, Boulder, CO. Convective Storms Div.
G. M. Morgan.
IN: Thunderstorms: A Social, Scientific, and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation

and Analysis, April 1982. p 149-180, 15 fig, 3 tab, 70 ref.

Descriptors: *Hail, *Networks, *Measuring instruments, *Remote sensing, *Weather data collections, Thunderstorms, Network design, Precipitation, Data acquisition, Radar, Meteorological data collections, Data collections, Tornadoes.

Techniques for measuring hailfall have undergone rapid improvements in the past 25 or 30 years through the introduction of simple but effective instruments in well-designed networks. The wind that accompanies hail has a strong influence on crop damage because it can impart a velocity component to the hailstone several times that acquired through free fall alone. For some purposes, volunteer observer networks of hailfall which were introduced 100 yr ago, are still useful today. Types of hail measuring or recording instruments in use today include the hailpad, hailcube, geophone hail gage, Illinois State Water Survey hail gage, hail-rain separator, time-resolving hail recorder, hailstone spectrometer, chilled-kerosene hailstone freezer, electro-optical hail recorder, hailstone sensor, and remote-sensing devices (radar). In developing hailfall observation networks, the ratio between the area of the hailstreak and the area represented by one grid point should be obtained for a sample of hailstreaks that represent the range and distribution of hailstreaks to be expected in the network. The size of the network determines the number of study events available each year and the number of instruments required to monitor them. (Geiger-PTT)
W86-02007

WEATHER RADAR,
National Severe Storms Lab., Norman, OK.
R. J. Doviak, D. Sirmans, and D. Zrnic.
IN: Thunderstorms: A Social, Scientific, and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 181-239, 24 fig, 92 ref.

Descriptors: *Radar, *Remote sensing, *Data acquisition, *Meteorological data collections, *Measuring instruments, Data collections, Weather data collections, Tornadoes, Storms, Cyclones.

A foundation of weather radar principles is given and related to the target's meteorological properties. Subjects such as light scattering properties of hydrometeors and extracting a target's properties from its echoes are reviewed. Radar parameters and echo power are related to the weights given to a hydrometeoric target's backscatter cross section. The radar signal path starting from the transmitter is followed through the antenna, along the beam to the target, and return to the receiver, highlighting along the way the important signal properties. The pulsed Doppler radar is discussed and a discrete target to develop radar principles and the radar equation are considered. The theory for conventional non-Doppler radar is also included. These principles are then extended to the more complex weather target, which is a conglomerate of discrete targets producing a continuous stream of echoes with rapidly fluctuating amplitude and phase. The origin of these fluctuations is demonstrated and the weather radar equation is developed. The weather Doppler spectrum and its principal moments are related to the spatial distribution of target reflectivity and its velocity. Example analyses of radar data from severe storms are presented. (Geiger-PTT)
W86-02008

MEASURING STORM RAINFALL BY RADAR AND RAIN GAGE,
National Severe Storms Lab., Norman, OK.
E. A. Brandes, and J. W. Wilson.
IN: Thunderstorms: A Social, Scientific and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 241-277, 13 fig, 4 tab, 90 ref, 1 append.

Descriptors: *Radar, *Remote sensing, *Rain gages, *Data acquisition, *Comparison studies, Measuring instruments, Data collections, Weather data collections, Rainfall, Gages, Storms, Meteorological data collections.

Radar overcomes the primary difficulties associated with rain gages; radar measurements are over an area, available in real time, and from a single location. The cost of radar is similar to that of a dense rain gage network. Rain gages are simple, less costly, but often erroneous in their measurements. Instrument errors and areal errors of rain gages are described. The radar equation and calculation of rainfall rate are described. Factors causing errors in radar measurement of rainfall may be grouped into three broad categories: estimating of radar reflective factor; time and space averaging of substantial variations in reflectivity; and variations in the reflectivity-rainfall rate (Z-R) relationship and below-beam effects. A comparison of areal radar and gage measurements was made in nine experiments using one average relationship for all storms. The very large storm-to-storm and within storm errors in radar rainfall estimates dictate that estimates should be adjusted further. Adjustments usually involve either specifying the Z-R relationship by storm type or keeping the Z-R relationship fixed and using rain gage observations to correct the radar estimates. (Geiger-PTT)
W86-02009

USE OF SATELLITE OBSERVATIONS,
National Oceanic and Atmospheric Administration, Boulder, CO. Weather Modification Program Office.
R. A. Maddox, and T. H. VonderHaar.
IN: Thunderstorms: A Social, Scientific and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 279-308, 22 fig, 52 ref.

Descriptors: *Satellite technology, *Thunderstorms, *Data acquisition, *Radiometry, *Weather data collections, Radar, Remote sensing, Storms, Weather modification, Meteorological data collections, Data collections, Cloud physics, Microwaves, Weather forecasting.

Satellite data are being developed for a variety of applications to thunderstorm research and operational forecasting and warning. The vertical-temperature profile radiometer has been used by NOAA satellites while the visible and infrared spin scan radiometer has been used by NASA. The rapid technological development of human/machine interactive computer systems that permits selective processing of digital satellite data is producing an increased amount of thunderstorm-related research. The NASA space shuttle will eliminate many restrictive weight and size limitations and allow more sophisticated infrared and microwave instruments to be placed in geosynchronous orbit. Satellite imagery is used in thunderstorm detection, monitoring, and forecasting by determining convective rainfall, monitoring movement and intensity of thunderstorm gust fronts, determining severe-thunderstorm/jetstream relationships and thunderstorm boundaries and intersections. Satellite technology has also been helpful in defining cloudtop tornadic signatures, studying mesoscale onvective weather systems, and examining cloudtop temperature fields, cloud motions and wind fields. Satellite technology has also aided studies involving thunderstorm microphysics such as weather modification. (Geiger-PTT)
W86-02010

EVAPOTRANSPIRATION OBTAINED FROM REMOTE SENSING METHODS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
J. L. Hatfield.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 395-416, 15 fig, 62 ref.

Descriptors: *Evapotranspiration, *Remote sensing, *Soil-water-plant relationships, Canopy, Temperature, Infrared imagery, Spectral analysis, Microwaves, Soil water, Irrigation.

State-of-the-art remote sensing techniques for estimating crop stress and evapotranspiration include evapotranspiration models, infrared thermometry, spectral measurements, and microwave techniques. Canopy temperatures can be used to estimate crop stress directly and to estimate water availability to a crop. Canopy temperature is also combined with traditional methods to indicate crop water demands. (Cassar-PTT)
W86-02134

USE OF AERIAL PHOTOGRAPHY AND REMOTE SENSING IN THE MANAGEMENT OF HAZARDOUS WASTES,
Ohio State Univ., Columbus.
For primary bibliographic entry see Field 5G.
W86-02224

DETECTION OF SUBSURFACE SALINITY WITHIN THE NORTHERN SLOPES REGION OF VICTORIA, AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
B. G. Williams, and M. Braunach.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 515-524, 4 fig, 1 tab, 12 ref.

Descriptors: *Saline water, *Salinity, *Ground water, Subsurface mapping, Subsurface water, Electromagnetic induction, Exploration, Australia, *Geophysical studies.

The application of electromagnetic induction to determine the magnitude and spatial variability of apparent electrical conductivity values, and their relation to underlying geology and secondary salinization, are discussed. The broad scale reconnaissance survey across the lower Northern Slopes of Victoria indicates the magnitude of potential secondary salinization in that region. It also indicates the inherent variability in the distribution of saline materials within the major geological formations. The relatively coarse sampling frequency (5 km) does not permit detailed speculation of problems and possible controls but it does indicate that approximately 300 km of that 500 km transect have a potential for secondary salinization should the groundwater system be conducive to the mobilization and transport of soluble salts. (Halterman-PTT)
W86-02310

PROGRESS REPORT: PERFORMANCE OF THE VIBRATING U-TUBE FLUID DENSITY GAGE FOR MEASURING SUSPENDED-SEDIMENT CONCENTRATION,
Geological Survey, Minneapolis, MN. Water Resources Div.
J. P. Beverage.
Available from Fed Inter-Agency Sed Proj, St Anthony Falls Hyd. Lab, Minneapolis, MN 55414. U.S. Corps of Engineers, 1984. 16 p, 5 fig, 3 ref.

Descriptors: Measuring instruments, *Sediments, Suspended load, *Settling tubes, *Fluid-density gage, *Suspended-sediment concentration, *Density cell.

The vibrating U-tube fluid-density gage shows promise in automating the measurement of suspended-sediment concentration. The gage may be operated with the U-tube in the upright vertical position to increase sensitivity at low sediment concentrations by stopping the flow and letting the sediment settle to the bottom. Sediment with a particle-size range of 62 to 1000 micrometers was tested, and the sensitivity of the instrument increased by a factor of five. The condensation of humidity within the case was proved to be the cause of scattered readings at water temperatures below 12C. The gage response is linear with case pressure. An improved reference oscillator was tested and shown to be satisfactory at ambient temperatures from 15 to 35C. The reference frequency was increased to 20 kHz from the 12.8 to kHz of the earlier studies. (USGS)
W86-02348

INSTRUMENTATION FOR MEASURING LAKE AND RESERVOIR EVAPORATION BY THE ENERGY-BUDGET AND MASS-TRANSFER METHODS,
Geological Survey, NSTL Station, MS. Water Re-

sources Div.
A. M. Sturrock.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-863, 1985. 21 p, 7 fig, 4 ref.

Descriptors: *Evaporation, *Mass transfer, *Energy budget, Reservoir evaporation, Lake evaporation, Air temperature, Water temperature, *Instrumentation, Psychrometer, Micrologger, Pyranometer.

Instrumentation currently used by the U.S. Geological Survey in studies of lake and reservoir evaporation is described in this paper. This instrumentation is used for the measurement of solar and terrestrial energy necessary to apply the mass-transfer or energy budget methods. The energy budget requires a quantative determination of all form of energy entering or leaving the lake as well as determination of the change in storage of energy within the lake. (USGS)
W86-02379

DISCHARGE RATINGS FOR CONTROL GAGES AT MISSISSIPPI RIVER LOCK AND DAM 11, DUBUQUE, IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02401

7C. Evaluation, Processing and Publication

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01921

SEDIMENT YIELDS IN EASTERN MONTANA: SUMMARY OF DATA AND PROPOSED TECHNIQUES FOR ESTIMATING SEDIMENT YIELDS FROM SMALL, UNGAGED WATERSHEDS,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-01922

GROUND-WATER DATA FOR MICHIGAN--1983,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01950

HYDROGEOLOGIC DATA FROM PARTS OF THE DENVER BASIN, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01952

GROUND-WATER RESOURCES OF LANFAIR AND FENNER VALLEYS AND VICINITY, SAN BERNARDINO COUNTY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01955

IRRIGATION DATA FROM CHASE, DUNDY, AND PERKINS COUNTIES, NEBRASKA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01957

JANUARY 1984 WATER LEVELS, AND DATA RELATED TO WATER-LEVEL CHANGES, WESTERN AND SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01960

DEVELOPMENT AND EVALUATION OF TECHNIQUES FOR THE DETERMINATION OF THE GROUND-WATER POTENTIAL IN THE SOUTHERN ORANGE FREE STATE AND NORTHERN CAPE PROVINCE; VOLUME 5: STATISTICS AND DATA ANALYSIS,
Water Research Commission, Pretoria (South Africa).
G. J. Van Tonder, and F. D. I. Hodgson.
December 1981. 165 p, 29 fig, 25 tab, 33 ref. K5/17.

Descriptors: *Data processing, *Computer programs, *Statistical analysis, *Geohydrology, Mathematical studies, Standard deviation, Correlation coefficients, Cluster analysis, Linear regression, Maps, Contour maps, Graphical analysis, Factor analysis, Principal component analysis, Orange Free State, *South Africa.

A computerized hydrogeochemical data bank is available for users in South Africa. Three groups of programs are described: (1) programs to read data into the computer and obtain an output in the desired format (all data on a single sample or tables of data for multiple samples), (2) programs for statistical analysis (mean, mode, median, standard deviation, correlation coefficients, multiple linear regression, factor analysis, cluster analysis), and (3) programs to obtain graphical representation of data (histograms, Piper diagrams, Schoeller diagrams, sodium adsorption diagrams, contour maps, etc.). (Cassar-PTT)
W86-01993

MUNICIPAL SOLID WASTE MANAGEMENT FACILITY LOCATION MAPPING: SUPPORT ACTIVITIES REPORT,
Texas Natural Resources Information System, Austin.
For primary bibliographic entry see Field 5E.
W86-02320

EVALUATION OF THE GROUND-WATER RESOURCES OF COASTAL GEORGIA: PRELIMINARY REPORT ON THE DATA AVAILABLE AS OF JULY 1983,
Geological Survey, Doraville, GA. Water Resources Div.
R. E. Krause, S. E. Matthews, and H. E. Gill.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-228, 1984. 55 p, 21 fig, 4 tab, 120 ref.

Descriptors: *Hydrologic data, *Groundwater, *Well use, *Georgia, *Coastal area, *Monitoring networks, *Principal artesian aquifer, *Floridan aquifer, Test-well drilling.

A compilation of ground-water data that have been collected for nearly 100 years in the coastal area of Georgia as part of cooperative activities between the U.S. Geological Survey and other agencies is presented in this report. The compilation of pertinent data indicates that information is available for use in the evaluation of the ground-water resources of the 13 counties of coastal Georgia. Included in this report is a fairly complete discussion of previous and ongoing investigations and monitoring networks, and an extensive list of references. Maps at 1:24,000, 1:100,000; and 1:1000,000 scales contain well locations and identifers for all wells in the Ground Water Site Inventory (GWSI) data base of the National Water Data Storage and Retrieval System (WATSTORE). Tabular summaries of selected site information from GWSI, including well identifiers and names, latitude-longitude location, depth of well, altitude of land surface, and use of water are presented. Water-use data from the National Water Use Data System, and water use for irrigation from the University of Georgia, Department of Agriculture survey, are tabulated. Also included are pertinent information on geophysical surveys and data obtained, and proposed project activities, particularly test-monitor well drilling. (USGS)
W86-02352

PRINCIPAL FACTS FOR GRAVITY STATIONS IN THE HUMBOLDT HOUSE GEOTHERMAL AREA, PERSHING COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-02358

RECORDS OF SELECTED WELLS, ST. MARYS AND CALVERT COUNTIES, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
D. D. Drummond.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. Maryland State Basic Data Report 14, 1984. 117 p, 41 fig, 10 tab, 6 ref.

Descriptors: *Hydrogeologic data, Data collections, *Hydrologic data, *Maryland, *Calvery County, *St. Marys County.

Hydrogeologic data for Calvery and St. Marys Counties in southern Maryland were compiled from previously published and unpublished sources. The report includes records of wells inventoried by the U.S. Geological Survey such as state permit number, owner's name, driller, date drilled, elevation, well depth, aquifer, water-level data, discharge data, specific capacity, use of water, and pump type. Also included are observation well lists, lists of available geophysical logs, descriptive logs, chemical quality analyses, and pumpage data, as well as location maps for all data sites. (USGS)
W86-02359

MASS WATER-LEVEL MEASUREMENTS OF FALL 1984 IN THE CENTRAL PLATTE RIVER BASIN, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
J. T. Dugan.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-193, 1985. 22 p, 3 fig, 1 tab.

Descriptors: *Groundwater levels, *Observation wells, Data collections, Hydrologic data, *Nebraska, Central Platte River basin, *Water level measurements.

Mass water-level measurements were conducted in the Central Platte River basin, Nebraska, for the purpose of providing data to the U.S. Bureau of Reclamation for the development of a detailed map of water-table conditions during the fall of 1984. The objective was to provide a network of observation wells at approximately 2- to 3-mile intervals. In October and November 1984, 736 wells were measured, of which 526 were measured as part of existing ground-water observation-well networks. The remaining 210 wells not previously measured and required complete inventorying. The report consists of maps of the study area and locations of the observation wells. An appendix of pertinent well data includes: legal location, land-surface altitude, depth-to-water, water-table altitude, date of measurement, and type of well. (USGS)
W86-02360

ANALYSIS OF GROUND-WATER-QUALITY DATA IN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. E. Davis, and G. D. Rogers.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4173, 1984. 177 p, 26 fig, 79 tabs, 56 ref.

Descriptors: *Water quality, Chemical properties, Environmental protection, *Montana, *WATSTORE, *Data collections.

Ground-water-quality data for Montana in the U.S. Geological Survey's computer data file WATSTORE were evaluated for nine geohydrologic units in part of the State east of the Rocky Mountains and for two geohydrologic units in the western mountainous part of the stated region. The availability of data for inorganic, trace, and organic constituents for each grouping of units was assessed. Median dissolved-solids concentrations for the groupings of units range from about 100 to 5,000 milligrams per liter. However, the number and distribution of data sites for some groupings of units wee inadequate to be representative of the aquifer as a whole. Concentrations of most trace constituents do not exceed Federal primary drinking-water standards, although exceptions occur. Few data were available for organic constituents. (USGS)
W86-02361

DRAINAGE BASINS IN ST. JOHNS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. W. Foose.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4232, 1984. 1 map, 3 fig, 3 tab, 4 ref.

Descriptors: *Drainage basins, Ditches, Divides, Beach, Drainage patterns, Tidal streams, *Maps, *Florida, *St Johns County, Hydrologic units, *Drainage areas.

The highest point in St. Johns County, Florida is only slightly above 65 feet above sea level and drainage divides are indistinct and readily influenced by cultural features. This report delineates some 80 drainage basins (or artificial equivalents to natural basins such as the Intracoastal Waterway) within the county and their areas in square miles. Total area of St. Johns County is about 670 square miles. (USGS)
W86-02363

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE OF PROVINCE, TEXAS,
Geological Survey, Lakewood, CO. Water Resources Div.
B. T. Brady, M. S. Bedinger, D. A. Mulvihill, J. Mikels, and W. H. Langer.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4121-B. 14 p, 3 fig, 38 ref.

Descriptors: *Groundwater levels, *Springs, *Maps, Basin and Range province, *Texas.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing hydrologic properties of the Texas part of the Basin and Range province. The first map, at a scale of 1:500,000, shows the approximate altitude of the water table, and the location, temperature, and flow of large springs. The altitude of the water table is shown by contours where sufficient data exists; otherwise it is shown by data points. Springs with flows of 10 gallons per minute or more have been mapped. A second map at a scale of 1:1,000,000 shows the depth to ground water and areas of basin fill or consolidated rocks. In areas where the depth to ground water is less than 500 feet, the depth is shown by lines of equal depth to water or data points where data are insufficient to draw lines. Areas where the depth to the water table is generally greater than 500 feet. (USGS)
W86-02366

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, TEXAS,
Geological Survey, Lakewood, CO. Water Resources Div.
B. T. Brady, M. S. Bedinger, and J. Mikels.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4121-A, 1984. 13 p, 3 fig, 38 ref.

Descriptors: *Groundwater, *Groundwater movement, *Maps, Selective withdrawal, Groundwater levels, Basin and Range province, *Texas.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing hydrologic properties of the Texas part of the Basin and Range province. The first map, at a scale of 1:500,000, divides the area into ground-water units, which approximate ground-water drainage. In addition to ground-water units, the map shows consolidated-rock areas, basin fill, generalized groundwater flow directions, and man-induced and natural-discharge areas. A second map at a scale of 1:1,000,000 shows quantity of ground-water withdrawal. (USGS)
W86-02367

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, J. S. Gates, and J. R. Stark.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4122-A, 1984. 22 p, 3, fig, 1 tab, 98 ref.

Descriptors: Groundwater, *Groundwater movement, *Maps, Groundwater levels, Selected withdrawal, Hydrogeology, *Basin and Range province, *Utah.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Utah part of the Basin and Range province. The first map, at a scale of 1:500,000 divides the area into ground-water units, which approximate ground-water drainage. In addition to ground-water units, the map shows consolidated-rock areas, basin fill, generalized groundwater flow directions, and man-induced and natural-discharge areas. A second map at a scale of 1:1,000,000 shows quantity of ground-water withdrawal. (USGS)
W86-02368

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA,
Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, W. H. Langer, and W. R. Moyle.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4116-A, 1984. 12 p, 3 fig, 40 ref.

Descriptors: Groundwater, *Groundwater movement, *Maps, Groundwater levels, Selective withdrawal, Hydrogeology, *Basin and Range province, *California.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the southern California part of the Basin and Range province. The first map, at a scale of 1:500,000, divides the area into ground-water units, which approximate groundwater drainage. In addition to ground-water units, the map shows consolidated-rock areas, basin fill, generalized ground-water flow directions, and man-induced and natural-discharge areas. A second map at a scale of 1:1,000,000 shows quantity of ground-water withdrawal. (USGS)
W86-02369

GEOLOGIC AND HYDROLOGIC DATA COLLECTED DURING 1976-1984 AT THE SHEFFIELD LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE AND ADJACENT AREAS, SHEFFIELE, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02372

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN MISSOURI, FISCAL YEAR 1985,
Geological Survey, Rolla, MO. Water Resources Div.
W. M. Kratzer, and K. L. Jenkins.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-188, 1985. 57 p, 8 fig, 1 tab, 64 ref.

Descriptors: *Missouri, *Hydrologic data, *Networks, Streamflow, *Gaging stations, Data collection, District projects, *Hydrologic reports.

Water-resource activities of the U.S. Geological Survey in Missouri consist of collecting hydrologic data and making interpretive studies. These projects are funded through joint-funding agreements with State and local agencies, transfer of funds from other Federal agencies, and direct Federal funds. These data and the results of the investigations are published or released by either the U.S. Geological Survey or by cooperating agencies. This report describes the hydrologic data-collection program and local or areal investigations in Missouri for fiscal year 1985 and provides a list of selected water-resources references for Missouri. (USGS)
W86-02375

GROUND-WATER DATA FOR GEORGIA, 1984,
Geological Survey, Doraville, GA. Water Resources Div.
J. S. Clarke, S. A. Longsworth, K. W. McFadden, and M. F. Peck.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-331, 1985. 150 p, 71 fig, 48 tab, 40 ref.

Descriptors: *Groundwater, *Water levels, Aquifers, *Georgia, Water quality, *Groundwater data, Groundwater levels, Groundwater quality.

Continuous water-level records from 155 wells and more than 800 water-level measurements made in Georgia during 1984 provide the basic data for this report. Selected wells illustrate the effects that changes in recharge and pumping have had on the various ground-water resources in the State. Daily mean water levels are shown in hydrographs for 1984. Monthly means are shown for the 10-year period 1975-84. Mean annual water levels ranged from 7 feet lower to 7 feet higher in 1984 than in 1983. Water-quality samples are collected periodically throughout Georgia and analyzed as part of a real and regional ground-water studies. Along the coast, chloride concentrations in the Floridan aquifer system generally remained steady. (USGS)
W86-02376

GAZATTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--MERRIMACK RIVER BASIN,
Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle, and R. A. Fontaine.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4284, 1984. 54 p, 5 fig, 5 tab, 32 ref.

Descriptors: *Drainage area, *Flow duration, *Low flow, *Frequency analysis, Flow characteristics, Streamflow, Surface water, *Massachusetts, Nashua River basin, Concord River basin, Shawsheen River basin, Lower Merrimack River basin, *Maps.

The Merrimack River basin in northeastern Massachusetts includes streams draining the Nashua (507 square miles), Concord (400 square miles), Shawsheen (78.0 square miles), and lower Merrimack (275 square miles) River basins. Drainage areas using the latest available 1:24,000 scale topographic maps were computed for the first time for

streams draining more than 3 square miles and were recomputed for data collection sites. Streamflow characteristics at 12 gaging stations were calculated using a new data base with daily flow records through 1981. These characteristics include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. Seven-day low-flow statistics are presented for 79 partial-reccrd sites and procedures used to determine the hydrologic characteristics of a basin are summarized. Basin characteristics representing 14 commonly used indices to estimate various streamflows are presented for 12 gaged streams. This gazetteer will aid in the planning and siting of water-resources related activities, and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02381

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, NEVADA,
Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, J. R. Harrill, W. H. Langer, J. M. Thomas, and D. A. Mulvihill.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations 83-4119-B, 1984. 11 p, 3 fig, 2 pl, 75 ref.

Descriptors: *Groundwater levels, Springs, Hydrologic data, Hydrogeology, *Basin and Range province, *Nevada, *Maps.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Nevada part of the Basin and Range province. The first map, at a scale of 1:500,000, shows the approximate altitude of the water table, and the location, temperature, and flow of large springs. The altitude of the water table is shown by contours where sufficient data exists; otherwise it is shown by data points. Springs with flows of 10 gallons per minute or more have been mapped. A second map at a scale of 1:1,000,000 shows the depth to ground water and areas of basin fill or consolidated rocks. In areas where the depth to water is less than 500 feet, the depth is shown by lines of equal depth to water or data points where data are insufficient to draw lines. Areas are shaded where the depth to the water table is generally greater than 500 feet. (USGS)
W86-02384

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, NEVADA,
Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, J. R. Harrill, and J. M. Thomas.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations 83-4119-A, 1984. 10 p, 3 fig, 2 pl, 75 ref.

Descriptors: *Groundwater, *Groundwater movement, Hydrologic data, Hydrogeology, Selective withdrawal, *Basin and Range province, *Nevada, *Maps.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Nevada part of the Basin and Range province. The first map, at a scale of 1:500,000, divides the area into ground-water units, which approximate ground-water drainage. In addition to ground water units, the map shows consolidated-rock areas, basin fill, generalized ground-water flow directions, and man-induced and natural-discharge areas. A second map at a scale of 1:1,000,000 shows quantity of ground-water withdrawal. (USGS)
W86-02385

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, ARIZONA,
Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, T. W. Anderson, and W. H. Langer.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-A, 1984. 7 p, 3 fig, 2 pl, 41 ref.

Descriptors: *Groundwater, *Groundwater movement, Hydrologic data, Selected withdrawal, Hydrogeology, *Basin and Range province, *Arizona, *Maps.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Arizona part of the Basin and Range province. The first map, at a scale of 1:500,000, divides the area into ground-water units, which approximate ground-water-table divides or topographic divides. In addition to ground-water units, the map shows consolidated-rock areas, basin fill, generalized ground-water flow directions, and man-induced and natural-discharge areas. A second map at a scale of 1:1,000,000 shows quantity of ground-water withdrawal. (USGS)
W86-02386

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, J. L. Mason, W. H. Langer, J. S. Gates, and J. R. Stark.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4122-B, 1984. 12 p, 3 fig, 1 pl, 123 ref.

Descriptors: *Groundwater levels, Springs, Hydrologic data, Hydrogeology, *Basin and Range province, *Utah, *Maps.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Utah part of the Basin and Range province. The first map, at a scale of 1:500,000, shows the approximate altitude of the water table, and the location, temperature, and flow of large springs. The altitude of the water table is shown by contours where sufficient data exists; otherwise it is shown by data points. Springs with flows of 10 gallons per minute or more have been mapped. A second map at a scale of 1:1,000,000 shows the depth to ground water, and areas of basin fill or consolidated rocks. In areas where the depth to water table is less than 500 feet, the depth is shown by contours of data points where data are not sufficient to draw contours. Areas are shaded where the depth to the water table is generally greater than 500 feet. (USGS)
W86-02387

SURFACE-WATER INFLOW TO PUGET SOUND, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
J. R. Williams.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4090. 6 plates, 11 tab.

Descriptors: *Stream discharge, Water quality, Regression analysis, *Surface waters, *Streamflow, Puget Sound, Strait of Juan de Fuca, *Washington, Exceedance probabilities, *Maps.

Estimates were made of the annual and seasonal mean discharges that have 10- (wet year), 50- (normal year), and 90- (dry year) percent probabilities of exceedance at the mouths of all streams in the Puget Sound area, Washington, that have a mean annual flow of 20 cu ft/sec. or more. The information, an important factor in assessing the quality of water in Puget Sound and the Strait of Juan de Fuca, is presented on five map plates. (USGS)
W86-02395

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN TEXAS--FISCAL YEARS 1982-84,
Geological Survey, Austin, TX. Water Resources Div.
R. U. Grozier, and L. F. Land.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-346, 1985. 60 p, 1 tab.

Descriptors: *Groundwater, *Surface water, *Water quality, *Hydrologic data collection, *Data collections, *Texas, Water-resources appraisals.

Water-resources activities in Texas include the collecting of hydrologic data, performing interpretive studies, and conducting research projects. This report describes the activities of the Water Resources Division of the U.S. Geological Survey in Texas for fiscal years (October to September) 1982 to 1984. (USGS)
W86-02396

STREAM DISCHARGE IN MICHIGAN--MISCELLANEOUS MEASUREMENTS,
Geological Survey, Lansing, MI. Water Resources Div.
D. J. Holtschlag, and D. V. Eagle.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-350, 1985. 344 p, 5 fig, 10 tab, 3 ref.

Descriptors: *Hydrologic data collections, *Streamflow, *Michigan, Discharge, Water yield.

This report contains 17,607 miscellaneous stream discharge measurements made at 2,897 sites in Michigan. An average of 515 measurements were made each year from 1960 through 1984; most of these were made from April through October of each year. Miscellaneous measurements include periodic and occasional measurements of streamflow at sites where systematic records are unavailable. (USGS)
W86-02409

APPROACH FOR APPRAISING THE ACCURACY OF SUSPENDED-SEDIMENT DATA,
Geological Survey, Sacramento, CA. Water Resources Div.
D. E. Burkham.
Available from Distribution Branch, USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Professional Paper 1333, 1985. 18 p, 4 fig, 1 tab, 14 ref.

Descriptors: *Statistical analysis, *Statistical methods, *Suspended sediments, Sediment discharge, Error analysis, Sediment concentration, Sand, Streams.

Procedures are presented for appraising the accuracy of suspended-sediment data. Types of errors involved are sampling error, spatial error, temporal error, and sediment-discharge error. The standard error of estimate is used to represent errors. Suspended-sediment data for 17 U.S. Geological Survey gaging stations in Arizona, California, Nebraska, New Mexico, Pennsylvania, and Washington are used in applications of the procedures. For the study sites, the magnitudes of the different types of error apparently vary directly with percentage of sediment-water mixture that is sand; when the percentage sand is relatively high, magnitudes of the different types of error have a relatively wide range. For seven sites of the Sacramento River, Calif., and its tributaries, the standard sampling error apparently can range from 2.5 percent when percentage sand is relatively low to 20 percent when percentage sand is relatively high. For 16 sites in Arizona, California, Nebraska, New Mexico, and Pennsylvania, the coefficient of variation for concentrations of suspended sediment

across streams apparently can range from 2.5 percent (low percentage sand) to 70 percent (high percentage sand). (USGS)
W86-02415

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--HUDSON RIVER BASIN,
Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4250, 1984. 24 p, 5 fig, 5 tab, 29 ref.

Descriptors: *Drainage flow, *Flow duration, *Low flow, *Frequency analysis, Flow characteristics, Streamflow, Surface water, *Massachusetts, Hoosic River basin, *Maps.

The Hudson River basin includes streams draining the Hoosic River (205 square miles), Kinderhook Creek (20.9 square miles), and Roeliff Jansen Kill (13.3 square miles) basins in western Massachusetts, eastern New York, and southern Vermont. Drainage areas, using the latest available 1:24,000 scale topographic maps, are re-computed for data-collection sites and computed for the first time for streams draining greater than 3 square miles. Basin characteristics representing 14 commonly used indices to estimate various streamflows are presented for the five gaged streams in the Hoosic River basin. Streamflow characteristics, representing statistics computed using a new data base with records through 1979, include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. Seven-day low-flow statistics are presented for 21 partial-record sites. The procedures used to determine the hydrologic characteristics are summarized. This gazetteer of hydrologic characteristics will aid in the planning and siting of water-resources-related activities and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02416

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--COASTAL RIVER BASINS OF THE NORTH SHORE,
Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4281, 1984. 60 p, 5 fig, 5 tab, 47 ref.

Descriptors: *Drainage area, *Flow duration, *Low flow, *Frequency analysis, *Flow characteristics, Streamflow, Surface water, *Massachusetts, Rowley River basin, Parker River basin, Ipswich River basin, Mystic River basin, Charles River basin, Neponset River basin, Weymouth River basin, Weir River basin, *Maps.

The coastal river basins of the North Shore and Boston Bay include streams draining the Parker River (60.4 square miles), Rowley River (9.9 square miles), Ipswich River (156 miles), Mystic River (66.0 square miles), Charles River (311 square miles), Neponset River (117 square miles), Weymouth Fore and Weymouth Back Rivers (about 63 square miles) and Weir River (about 20 square miles) basins. The study area in eastern and northeastern Massachusetts also includes the minor river basins draining into Massachusetts Bay, Ipswich Bay, or the Atlantic Ocean. Drainage areas using the latest available 1:24,000 scale topographic maps were computed for the first time for streams draining more than 3 square miles and were recomputed for data-collection sites. Streamflow characteristics at 15 gaging stations were calculated using a new data base with daily flow records through 1981. These characteristics include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. Seven-day low-flow statistics are presented for 95 partial-record sites and the procedures used to determine the hydrologic characteristics of a basin are summarized. Basin characteristics representing 14 commonly used indices to estimate various streamflows are presented for 15 gaged streams. This gazetteer will aid in the planning and siting of water-resources related activities and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02418

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--CONNECTICUT RIVER BASIN,
Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4282. 110 p, 10 ill, 5 tab, 39 ref.

Descriptors: *Drainage area, *Flow duration, *Low flow, *Frequency analysis, Flow characteristics, Streamflow, Surface water, *Massachusetts, *Connecticut River basin, *Maps.

The Connecticut River basin study area includes streams draining the Ashuelot River (6.6 square miles), Millers River (389 square miles), Deerfield River (663 square miles), Chicopee River (727 square miles), Westfield River (517 square miles), Farmington River (158 square miles), and Connecticut River lowlands (656 square miles) basin in western Massachusetts, northern Connecticut, southern Vermont, and southern New Hampshire. Drainage areas, using the latest available 1:24,000 scale topographic maps, were computed for the first time for streams draining more than 3 square miles and were re-computed for data-collection sites. Streamflow characteristics at 45 gaging stations, representing statistics were calculated using a new data base with daily flow records through 1981. These characteristics include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. Seven-day low-flow statistics are presented for 118 partial-record sites, and the procedures used to determine the hydrologic characteristics of a basin are summarized. Basin characteristics representing 14 commonly used indices to estimate various streamflows are presented for 54 sites in the Connecticut River basin. This gazetteer will aid in the planning and siting of water-resources related activities and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02419

8. ENGINEERING WORKS

8A. Structures

MODEL STUDY ON WAVE ABSORBERS FOR APPLICATION IN HARBOURS ALONG THE SOUTH AFRICAN COASTLINE,
National Research Inst. for Oceanology, Stellenbosch (South Africa). Coastal Engineering and Hydraulics Div.
D. J. P. Scholtz.
Available from the National Technical Information Service, Springfield, VA 22161 as N83-11686, Price codes: A06 in paper copy, A01 in microfiche. CSIR Report T/SEA 8114, September 1981. 117 p, 73 fig, 7 tab, 20 ref.

Descriptors: *Hydraulics, *Erosion control, *Waves, Harbors, *South Africa, Model studies, Coastal engineering, *Breakwaters, *Shore protection, *Bank protection, Wave absorbers.

The performance of wave absorbers for South African harbors was studied using a model. Tests were done on rubble slopes, dolos slopes, discontinuous composite rubble slopes, patented absorber blocks, and a column wave absorber. Generally, the reflection coefficients were high when the relative depth was low, and vice versa. The wave steepness had an insignificant effect on the reflection coefficient in the wave steepness range of 0.004 to 0.024. The individual mean reflection coefficients for dolos slopes and rubble slopes were similar, 0.37 and 0.35, respectively, for relative depths of 0.10 and 0.13 and for wave steepness of 0.004-0.024. The reflection coefficients for narrow structures (6.0-6.5 m wide in the model) were high (0.6-0.8). Smaller reflection coefficients were obtained for wider structures. For example, reflected wave heights were 0.3-0.4 for structures 18.00-18.75 m wide in the prototype. With the column wave absorber, reflected wave height decreased linearly with increase in width. The efficiency of the most effective hollow-block type (column) and of the slope type (composite slope with ratio of depth of top of vertical face of the discontinuous composite rubble slope below SWL to water depth at structure = 0.4) wave absorbers was similar (reflected wave height = 0.5) for w/d (width/water depth) = 1. The latter was more efficient for $w/d > 1$ and less efficient for $w/d < 1$. (Cassar-PTT)
W86-02000

AIR DEMAND AND VIBRATION MEASUREMENTS, WYNOOCHEE DAM, WYNOOCHEE RIVER, WASHINGTON,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-02002

CONDITION SURVEY OF CEDARS LOCK AND DAM, LOWER FOX RIVER, WISCONSIN,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
R. L. Stowe, and J. C. Ahlvin.
Miscellaneous Paper SL-82-4, June 1982. Final Report. 114 p, 2 fig, 5 tab, 26 plates, 2 app, 1 exhibit, 7 ref.

Descriptors: *Cedars Lock and Dam, *Wisconsin, *Dam inspection, Concrete dams, Elastic modulus, Shear strength, Triaxial strength, Poisson's ratio.

A condition survey was performed at Cedars Lock and Dam on the Lower Fox River, Wisconsin. Results of the field investigation and laboratory tests indicated that the concrete in the lock and dam is locally cracked and lightly deteriorated but structurally sound. Rock masonry in the lock appears sound even though the outside surface is weathered. Cycles of freezing and thawing have caused the deterioration. The lock and dam is founded on competent bedrock. Soundings should be made to detect any scouring behind the dam. It is suggested that the reinforced steel in the tainter gate piers, adjacent to the hinge pins, be examined for corrosion. The field investigation included drilling for core samples of concrete, foundation rock, and backfill. Selected specimens of these materials were tested in the laboratory for certain physical and mechanical properties. Data on unit weight, compression wave velocity, compression strength, water content, elastic moduli and Poisson's ratio are presented for concrete cores. Data on effective and dry unit weight, water content, compression shear strength are presented for the rock cores. (Author's modified-abstract)
W86-02036

8B. Hydraulics

MODEL STUDY ON WAVE ABSORBERS FOR APPLICATION IN HARBOURS ALONG THE SOUTH AFRICAN COASTLINE,
National Research Inst. for Oceanology, Stellenbosch (South Africa). Coastal Engineering and Hydraulics Div.
For primary bibliographic entry see Field 8A.
W86-02000

AIR DEMAND AND VIBRATION MEASUREMENTS, WYNOOCHEE DAM, WYNOOCHEE RIVER, WASHINGTON,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.

E. D. Hart.
Miscellaneous Paper HL-82-2, December 1982. Final Report, 45 p, 10 fig, 5 tab, 16 plates, 13 ref.

Descriptors: *Hydraulics, *Vibrations, *Dams, *Gates, Air demand, Hydraulic structures, *Wynochee Dam, *Washington, Sluice gates.

Tests were conducted at the Wynoochee Dam, Washington, after vibrations were noted during sluice discharges. The measurement program included (a) the magnitude of vibrations occurring at the dam, the Vista House, and sluice gate, (b) gate-lip pressure fluctuations, (c) air flow rates, (d) the correlation between the gate and Vista House vibrations. Measurements were made with gate openings at 1-ft increments from 1 to 10 ft with an essentially full pool. Some correlation was seen between the frequency of the gate-lip pressure fluctuations and both the accelerations of the Vista House and the air-vent pressure fluctuations during the test with a gate opening of 9 ft. The maximum pk-pk acceleration recorded during the test was 0.0008 g. The maximum recorded air-vent velocity and head loss were within suggested limits. The ratio of air discharge through the vent and water discharge in the sluice plotted reasonably well on the suggested design curve. Air-vent flow reached a maximum when the sluice gate was fully open. Air flowed into the sluice exit portal at all gate openings for which measurements were made. (Cassar-PTT)
W86-02002

8C. Hydraulic Machinery

HAND-PUMP TECHNOLOGY FOR THE DEVELOPMENT OF GROUNDWATER RESOURCES,
Agency for International Development, Washington, DC.
F. E. McJunkin, and E. H. A. Hofkes.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 37-52, 1 fig, 11 ref.

Descriptors: *Groundwater, *Pumps, *Pump wells, *Water supply development, *Developing countries, Pump testing, Water supply, Water resources development, Maintenance costs, Models, Rural areas.

In areas where groundwater is readily available at moderate depth, constructing a number of wells fitted with hand pumps is by far the cheapest means of providing a good water supply. The most common hand pump is the reciprocating type. Inherent features of the reciprocating hand pump are subject to friction and wear. The diaphragm pump is another type of positive displacement pump. In the rotary-type pump, the helical rotary requires no valves nor cup seals, and in place of the reciprocating lever linkage of the pump head, it uses a rotary crank with a right-angle gearbox to turn the rotor. The local manufacture of the hand pump is desireable due to lower capital costs of production, transportation savings, reduction in foreign exchange requirements, stimulation of local initiative, industry and labor, and better availability and access to repair and replacement parts. Most hand-pump maintenance programs can be characterized as a one-level or two-level system. The one-level system is one where all maintenance is the responsibility of the central organization. In the two-level organization, maintenance is shared with local villages or communities. Hand pumps are compared and selected on the basis of relative total cost, capital costs of purchase and installation, plus costs of operation and maintenance. A protocol for evaluating and comparing hand pumps is now under development. (Geiger-PTT)
W86-02327

RENEWABLE ENERGY PUMPING FROM RIVERS AND STREAMS,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
E. J. Schiller.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 53-64, 6 fig, 1 tab, 6 ref.

Descriptors: *Pump turbines, *Streams, *Pumps, *Water supply development, *Developing countries, Hydraulic equipment, Streamflow, Rivers, Pumping, Pump testing, Water supply, Water resources development, Maintenance costs.

In developing countries, there are many situations where water is available from a nearby stream. Various devices have been constructed to utilize the energy available in flowing streams. This chapter reviews two of the more successful devices: the hydraulic ram pump (hydram) and the low head turbine pump. The hydram converts pressure energy to mechanical work, while the low-head turbine pump converts kinetic energy to mechanical work. The hydram works more efficiently, and in general its capital cost is approximately half that of the Platapump turbine pump. There is, however, ancillary equipment that must be installed with the hydram (feed tank, drive pipe, pump compartment), making it a rather permanent installation. The turbine pump can be installed quite easily with a simple dam, and is fairly temporary and portable. In terms of operation and maintenance, the hydram, with two moving valve parts, would probably be easier to maintain. (Geiger-PTT)
W86-02328

WIND-POWER PUMPING,
Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
G. M. Bragg.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Sciences, Ann Arbor, MI, 1982. p 65-84, 7 fig, 4 tab, 3 ref.

Descriptors: *Pumps, *Pump turbines, *Wind, *Hydraulic equipment, Pumped storage, Pumping, Turbines, Pump testing, Hydraulic machinery, Design criteria, *Windmills.

Several aspects of wind power pumping are outlined, with emphasis on the data needed to decide on the basic types of wind power devices to be used and the availability of wind for power generation. Historically, most windmills have been used for grinding and water pumping. When deciding on windmill location, optimum geographic placement, variation of wind speed with heights and time, and maximum winds for stress analysis should be considered. Windmill designs should be stress-analyzed comprehensively before construction. The most common type of water pumping windmill is the American farm windmill. Many new designs of this type of windmill are becoming available. These new machines are capable of pumping water using positive-displacement pumps at depths up to 200 or more meters. The mechanical simplicity of vertical axis water pumping windmills suggests that machines of this type may become popular in the future. The most common positive-displacement pump for water applications at present is the reciprocating type. In North America, centrifugal pumps have been used to provide water pumping while being driven electrically by submersible motors. In the case of water pumping, the economic and engineering advantages are often strongly in favor of wind power. The peak achievable efficiency for aerodynamic optimization is 0.59, if angular momentum effects, drag and tip losses are ignored. Optimization of a wind turbine connected to a pump or electrical generator is considered. (Geiger-PTT)
W86-02329

8D. Soil Mechanics

INFLUENCE OF A SHALLOW WATER TABLE ON CRATERING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
B. L. Carnes.
Technical Report SL-81-6, September 1981. Final Report. 118 p, 21 fig, 10 tab, 9 ref, 4 append. 4A762719AT40.

Descriptors: *Soil mechanics, *Excavation, *Explosives, *Water table, Rapid excavation, Water level, Sand, Craters, Shallow water table.

The influence of a shallow water table on crater shapes and sizes in various types of soils was investigated. Tests using high-explosive charges ranging from 1 to 322 pounds were conducted at four separate sites. Site 1 was a specially constructed sand basin with a variable water table level. Site 2 was a natural sandbar of the Mississippi River near Vicksburg. Site 3 was on a natural sand site in central Florida, and Site 4 was a layered clay/sand site at Camp Shelby, Mississippi. Results showed that craters of drastically different shapes can be formed in the presence of a near-surface water table if the water table is in a highly saturated, loose, granular material. Wide, shallow craters were caused by soil liquefaction in loose, saturated, fine medium-loose sands; however, in a relatively dense sand that was not fully saturated, craters were 5 to 10% smaller in radius and depth than normal (in homogeneous soil), but still regular and bowl-shaped. In a clay/sand environment, craters tended to be about 10 to 15% wider than normal because of sloughing crater slopes of soft clay caused by the shallow water table in the sand.
W86-01999

RELATIONSHIP OF LABORATORY AND FIELD DETERMINED HYDRAULIC CONDUCTIVITY IN COMPACTED CLAY SOILS,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 2F.
W86-02119

8E. Rock Mechanics and Geology

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, BASIN AND RANGE PROVINCE, UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Jenness.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4122-D, 1984. 11 p, 2 fig, 68 ref.

Descriptors: *Granitic rocks, Aquifers, Hydrogeology, *Geologic maps, *Basin and Range province, Utah.

Outcrops of granitic rocks have been delineated in Utah as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, geologic age, distribution, and sources of data of the granitic rocks, are described. (USGS)
W86-01938

MAP SHOWING OUTCROPS OF PRE-QUATERNARY ASH-FLOW TUFF AND LAHARIC BRECCIA, BASIN AND RANGE PROVINCE, NEW MEXICO,
Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Jenness, K. Roggensack, and D. A. Lopez.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4118-F, 1984. 24 p, 93 ref.

Descriptors: *Ash-flow tuff, *Laharic breccia, *Aquifers, Hydrogeology, Basin and Range province, *New Mexico, Geologic maps.

Outcrops of ash-flow tuff and laharic breccia have been delineared in New Mexico as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, thickness, geologic age, distribution, and sources of data of the rocks are described. Also, caladreas and cauldrons from which the major tuffs erupted are described. (USGS)
W86-01939

MAP SHOWING OUTCROPS OF THICK, DOMINANTLY ARGILLACEOUS SEDIMENTARY AND METASEDIMENTARY ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,
Geological Survey, Lakewood, CO. Water Re-

sources Div.
W. D. Johnson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-E, 1984. 11 p, 2 fig, 2 pl, 61 ref.

Descriptors: *Argillaceous Rocks, Aquifers, *Geologic maps, *Basin and Range province, *Arizona.

Outcrops of formations containing thick units of argillaceous rocks in Arizona as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, thickness, geologic age, distribution of the rocks, and the sources of data are described. (USGS)
W86-01945

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,
Geological Survey, Lakewood, CO. Water Resources Div.
W. D. Johnson, and R. B. Scarborough.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-D, 1984. 33 p, 2 fig, 2 pl, 135 ref.

Descriptors: *Granitic rocks, Aquifer, *Geologic maps, *Basin and Range province, *Arizona.

Outcrops of granitic rocks of part of Arizona have been mapped as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, geologic age, distribution, and the sources of data of the granitic rocks are described. (USGS)
W86-01946

MAP SHOWING OUTCROPS OF PRE-QUATERNARY BASALTIC ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,
Geological Survey, Lakewood, CO. Water Resources Div.
W. D. Johnson, and R. B. Scarborough.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-G, 1984. 19 p, 3 fig, 2 pl, 93 ref.

Descriptors: *Basaltic rocks, Aquifers, *Geologic maps, *Basin and Range province, *Arizona.

Outcrops of basaltic rocks older than 2 million years have been delineated in Arizona as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, thickness, geologic age, distribution, and the sources of data for the basaltic rocks, are described. (USGS)
W86-01947

MAP SHOWING OUTCROPS OF THICK, DOMINANTLY AGRILLACEOUS SEDIMENTARY AND METASEDIMENTARY ROCKS, BASIN AND RANGE PROVINCE, UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
W. D. Johnson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4122-E, 1984. 10 p, 1 fig, 1 tab, 52 ref.

Descriptors: *Agrillaceous rocks, Aquifers, Geologic maps, *Basin and Range province, *Utah.

Outcrops of thick argillaceous sedimentary and metasedimentary rocks generally in excess of 500 feet thick have been delineated in Utah as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The sources of data, lithologic chracter, thickness, and distribution of thick argillaceous geologic units ranging in age from Late Proterozoic to Late Cretaceous are described. (USGS)
W86-01948

MAP SHOWING OUTCROPS OF PRE-QUATERNARY ASH-FLOW TUFFS AND VOLCANICLASTIC ROCKS, BASIN AND RANGE PROVINCE,
Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Jenness, D. A. Lopez, and J. R. LaFortune.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-F, 1984, 16 p, 2 fig, 66 ref.

Descriptors: *Tuffs, *Volcaniclastic rocks, Aquifers, *Geologic maps, *Basin and Range province, *Arizona.

Outcrops of ash-flow tuffs and valcaniclastic rocks older than 2 million years have been delineated in Arizona as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, thickness, geologic age, distribution, and the sources of data for the rocks, are described. (USGS)
W86-01972

MAP SHOWING OUTCROPS OF GRANITIC ROCKS AND PRE-QUATERNARY ASH-FLOW TUFFS, BASIN AND RANGE PROVINCE, OREGON,
Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Jenness, K. A. Sargent, and D. A. Lopez.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4120-D, 1984. 12 p, 2 fig, 41 ref.

Descriptors: *Granitic rocks, *Ash-flow tuffs, Calderas, *Geologic maps, Aquifers, *Basin and Range province, *Oregon.

Outcrops of granitic rocks and pre-Quaternary ash-flow tuffs have been delineated within the Basin and Range province or Oregon as part of a study by the U.S. Geological Survey to identify potentially suitable regions for future study for disposal of high-level nuclear waste within the Basin and Range province, western United States. The distribution, lithologic character, geologic and, if available, radiometric age, thickness (where appropriate), and sources of data of the geologic units are described. Locations of known and postulated calderas are shown, and they are briefly described. (USGS)
W86-01973

MAP SHOWING OUTCROPS OF PRE-QUATERNARY BASALTIC ROCKS, BASIN AND RANGE PROVINCE, OREGON,
Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Jenness, K. E. Sargent, and D. A. Lopez.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4120-E, 1984. 8 p, 2 fig, 27 ref.

Descriptors: *Basaltic rocks, *Geologic maps, Hydrogeology, *Basin and Range province, *Oregon, Aquifers.

Outcrops of basaltic rocks have been delineated in Oregon as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, thickness, geologic age, distribution, and sources of data of the basaltic rocks are described. (USGS)
W86-01974

PRINCIPAL FACTS FOR GRAVITY STATIONS IN THE HUMBOLDT HOUSE GEOTHERMAL AREA, PERSHING COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
B. G. Duffrin, D. L. Berger, and D. H. Schaefer.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-163, 1985. 11 p, 1 tab, 2 ref, 1 fig.

Descriptors: *Gravity Studies, *Geophysics, Gravimetric prospecting, *Humboldt House area, Pershing County, *Nevada.

Principal fact for 172 gravity stations in and near Humboldt House, Nevada are tabulated; they consist of latitude, longitude, altitude, observed gravity, free-air anomaly, terrain correction, and Bouguer anomaly values, at a bedrock density of 2.67 grams per cubic centimeter. (USGS)
W86-02358

8G. Materials

LABORATORY INVESTIGATION OF PHYSICAL PROPERTIES OF FLEXIBLE MEMBRANE LINERS (FML),
Carlisle SynTec Systems, PA.
B. D. Gish, and W. E. Witherow.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co. Lancaster, PA. 1984. p 510-519, 14 fig.

Descriptors: *Membranes, *Impervious membranes, *Materials testing, *Linings, Materials engineering, Rubber, Elastomers, Polymers.

A wide spectrum of physical properties, especially durability and degradation, for the most common non-reinforced and fabric reinforced flexible membrane liners (FML's) e.g., butyl and ethylene propylene diene monomer (EPDM), rubbers and thermoplastic polyvinyl chloride (PVC), chlorinated polyethylene (CPE) and chlorosulfonated polyethylene (CSM) were investigated. All of these materials are used widely today in many canal, reservoir, wastewater, and dam projects. Testing was performed in accordance with the latest American Society of Testing and Materials methods. Water resistance, tensile strength, elongation, dimensional stability, and puncture resistance were determined on five commercially available membranes (Butyl rubber, EPDM, rubber, thermoplastics CPE, thermoplastic PVC, and Hypalon). Physical characteristics were determined after heat aging for 28 days at 70degrees and for 7 days at 116 degrees. Butyl rubber showed the least dimensional changes, the highest puncture resistance, good retention of brittle point, and the least permeability. Thermoplastic PVC and CSM increased in tear resistance after heat aging. PVC exhibited the worst tensile strength retention after 28 days at 70 degrees. (Geiger-PTT)
W86-02120

8H. Rapid Excavation

INFLUENCE OF A SHALLOW WATER TABLE ON CRATERING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
For primary bibliographic entry see Field 8D.
W86-01999

8I. Fisheries Engineering

HABITAT SUITABILITY INDEX MODELS: REGRESSION MODELS BASED ON HARVEST OF COOLWATER AND COLDWATER FISHES IN RESERVOIRS,
Fish and Wildlife Service, Fayetteville, AR. National Reservoir Research Program.
For primary bibliographic entry see Field 2A.
W86-01985

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

TRAINING OF COUNTERPARTS,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
E. J. Schiller.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 343-361, 1 fig, 11 ref.

Descriptors: *Education, *Training, *Water supply development, *Sanitation, *Developing

countries, Case studies, Project planning, Future planning, Manpower, Personnel.

Training of personnel will be a key factor in any expansion of water supply and sanitation systems. To train personnel, students may go outside the country for specialized training not available within the country, outside teachers may come into the country, or local teachers may be used to train local personnel using local institutions. Training plans should be preceded by a proper manpower survey. Most developing countries focus on operation/maintenance as the most critically needed training. Practical on-the-job training is also often lacking. Trained personnel require incentives to stay on the job after training. Failure to fulfill training requirements may be considered a breech of contract where certain training must gradually be shifted from outside training advisors to local trainers. Four projects involving a large training component are described. These are: training in rural water supply in Malawi, training the professionals and technicians in Tanzania, a training project for operation and maintenance in Kenya, and training of trainers in the East Caribbean. The PANO/GIBA report has defined the major activities of the training program. These include: development of the training delivery system organization, training of trainers, development of training/job manuals, and manager/supervisor workshop and premier briefing. (Geiger-PTT)
W86-02342

9D. Grants, Contracts, and Research Act Allotments

HISTORY OF THE STATE WATER RESOURCES RESEARCH INSTITUTE PROGRAM,
Geological Survey, Reston, VA. Water Resources Div.
J. S. Burton.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-736, 1984. 49 p, 6 fig, 7 tab, 64 ref.

Descriptors: Administration, Education, Administrative agencies, *Water Resources Institutes, Universities, *Technology transfer, History, Manpower, Research priorities, *State Water Resources Research Institute Program, *Water Resources Scientific Information Center.

The State Water Resources Research Institute Program, established in 1964, consists of 54 Water Resources Research Institutes located at land-grant universities in each of the 50 states and Puerto Rico, the District of Columbia, Guam, and the Virgin Islands. The program evolved from the Water Resources Research Act of 1964, as amended, the Water Research and Development Act of 1978, Public Law 94-457, and the Water Research and Development Act of 1984. These laws authorize the following components of the Institute Program: (1) the annual allotment and matching grants program for the institutes and (2) the additional and saline water research programs for organizations in addition to the State Water Resources Research Institutes. This report summarizes the legislative history, budget history, research program development, and program accomplishments. The State Water Resources Research Program has been administered to by the Office of Water Resources Research (OWRR) (1964-1974), the Office of Water Research and Technology (OWRT) (1974-1982), the Office of Water Policy (OWP) (1982-1983), and the U.S. Geological Survey (USGS) (1983-present). (USGS)
W86-02347

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN MISSOURI, FISCAL YEAR 1985,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02375

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN TEXAS--FISCAL YEARS 1982-84,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02396

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

PARAHO ENVIRONMENTAL DATA: BIBLIOGRAPHY,
Development Engineering, Inc., Rifle, CO.
L. K. Talley.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-019378, Price codes: A02 in paper copy, A01 in microfiche. May 1981. 19 p. EP-78-C-02-4708.A000.

Descriptors: *Bibliographies, *Water pollution effects, *Oil shale, *Coal liquefaction, Toxicity, Land reclamation, Revegetation, Vegetation establishment, Public health, Safety, Leachates.

A bibliography on oil shale processing includes references on process characterization, air quality, water quality, land reclamation and revegetation, biological effects, occupational health and safety, and end use. (Cassar-PTT)
W86-01983

FLUCTUATING WATER LEVELS IN RESERVOIRS; AN ANNOTATED BIBLIOGRAPHY ON ENVIRONMENTAL EFFECTS AND MANAGEMENT FOR FISHERIES,
Fish and Wildlife Service, Fayetteville, AR.
G. R. Ploskey.
Technical Report E-82-5, May 1982. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 142 p. Intra-Army Order WESRF-80-112.

Descriptors: *Bibliographies, *Environmental effects, *Water level fluctuations, *Reservoirs, *Aquatic life, Aquatic habitats, Habitats, Fish, Invertebrates, Aquatic plants, Macrophytes, Productivity, Zooplankton, Limnology, Water quality, Algae, Nutrients, Drawdown, Erosion, Temperature, Water temperature, Turbidity, Falling stage, Rising stage.

The effects of reservoir water level fluctuations on fish is the subject of a 367-reference annotated bibliography. Affected are physicochemical variables, alagae, aquatic invertebrates, fish, fishing, erosion, and reservoir aesthetics. Research on natural lakes, ponds, marshes, and floodplains is included when data contribute to an understanding of aquatic systems in general. A subject index lists several main headings: biology, fish taxa, and limnology (chemical and physical). Examples of subjects under the main headings are fish (with 17 subheadings), drawdown, high water, erosion, temperature, reservoirs, receding waters, and rising waters. (Cassar-PTT)
W86-02033

WATER QUALITY, MACROINVERTEBRATES, AND FISHERIES IN TAILWATERS AND RELATED STREAMS: AN ANNOTATED BIBLIOGRAPHY,
Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
C. H. Walburg, J. F. Novotny, K. E. Jacobs, W. D. Swink, and T. M. Campbell.
Technical Report E-81-8, May 1981. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 200 p. Interagency No. WES 79-04.

Descriptors: *Bibliographies, *Environmental effects, *Reservoirs, *Aquatic life, *Tailwater, Fish, Invertebrates, Aquatic habitats, Habitats, Streams, Dams, Flow, Water quality.

An annotated bibliography lists available literature information on water quality, macroinvertebrates, and fish in tailwaters and related streams. It is divided into two sections: (1) tailwater studies - references which show the project-imposed changes in water flow and quality on the tailwater environment and downstream biota and (2) stream studies - selected references on stream studies which are applicable to tailwater research. (Cassar-PTT)
W86-02035

10D. Specialized Information Center Services

HISTORY OF THE STATE WATER RESOURCES RESEARCH INSTITUTE PROGRAM,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 9D.
W86-02347

10F. Preparation Of Reviews

REVIEW OF THE CHEMISTRY AND ENVIRONMENTAL FATE OF REACTIVE OXIDANT SPECIES IN CHLORINATED WATER,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5F.
W86-02136

REVIEW OF ANALYTICAL METHODS FOR REACTIVE OXIDANT SPECIES IN CHLORINATED WATERS,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5A.
W86-02177

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2 WATER CYCLE

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